ED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

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COMING SOON

An article explaining the function and usefulness of water-displacing fluids in the plating room.

A review of the practical methods for electroplating on aluminum alloys, including plating over immersion deposits, zincate films, and anodized coatings. Complete operating details will be given.

Vacuum metallizing of plastics, a new competitor to plating techniques, will be covered from the practical shop operating viewpoint.

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in the field of *Zinc Die Castings*

Zinc as a metal is not particularly difficult to finish. Being relatively soft, you have to watch out for scoring and dragging, of course, but other than that the problem is usually one of degree. How much should the surface be processed prior to plating and what's the best way of doing it? Remember proper pre-plate finishing can do away with surface defects that plating could not hope to hide.

Lea Technicians can help you on this as they have helped countless others finishing die castings. Authorities on metal finishing by virtue of their more than twenty-five years' constant study of finishing problems, they are in position to make specific suggestions as to the best finish and how to produce it.

We suggest that you send samples of unfinished pieces together with a finished piece or clear description of the finish you want and let our laboratory go to work on your problem. If you would like to first study the problem for yourself send for the "Zinc Die Casting Section of our General Catalog on Finishing."

BURRING, BUFFING AND POLISHING... MANUFACTURERS AND SPECIALISTS IN THE DEVELOPMENT OF PRODUCTION METHODS, EQUIPMENT AND COMPOSITIONS.

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Keep Your Powder Dry!

The bursting of the 'cold war' bubble in the Korean area should be the signal for a lot of serious thought by the entire plating industry. The plain truth of the matter is that we are again at war, which means that drastic changes are in the offing for the industry which may exceed anything that came about during the last war. The questions of "What?" and "How Soon?" now depend only on the pace of the present conflict.

Even those who are unwilling to admit that we face a full scale war must concede that from here on our thinking and economy will be geared to a war-time basis, and the impact on the plating industry could be especially severe.

At the outset of the last war restrictions were placed on the plating of many items. Decorative nickel and chrome finishes were almost entirely forbidden, and cadmium and tin plating were drastically curtailed. If the need arises again, it can be expected that such plating restrictions on non-military items would be repeated, with the addition that even zinc and copper plating would be on the taboo list. What nickel plating is done will probably not be bright nickel, and chrome plating would be almost entirely hard chrome for tools, dies, and critical military parts. Chemical conversion coatings for steel and the light alloys, such as anodizing, phosphating, blackening, etc. would be in wide demand, and would help take up the slack left by the banning of plated finishes. A decided increase in gold and silver for military electronic equipment could be expected.

These comments are not intended to create alarm or confusion, but merely to set the stage for constructive thinking and planning by all concerned. When and if restrictive orders are necessary they will come swiftly and unequivocally, so a little planning in advance would be time well spent. The plating industry can and will do its share when the situation calls for it. One note of caution—Reckless buying of plating materials in great excess of actual needs would be futile; restrictions will be based on the end use of the items, and even stocks of critical materials in individual plants would be frozen. Authorized use would automatically insure full government aid in procuring the necessary materials.

The situation calls for getting our feet off of our desks and solidly on the ground, and keeping our shirts on, but with our sleeves rolled up!

W. A. Raymond

Editor

Abstracts of Papers Presented at A. E. S. Convention

Levelling in Cobalt-Nickel Plating Baths

By Louis Weisberg

The composition and operating conditions for levelling types of cobalt-nickel baths were discussed. A bath of the following composition was recommended:

Nickel sulfate	48 oz./gal.
Nickel chloride	4 "
Formic acid	2 "
Boric acid	5-5½ "
Cobalt sulfate	0.4 "
Formaldehyde	0.3 "

The bath is operated at a pH of 2.3, a temperature of 160° to 170°F. and a current density of 40 amps/sq. ft.

Agitation by air or solution movement is essential, as well as complete absence of organic impurities. The author stated that bright or semi-bright deposits could be obtained with approximately the same levelling power. In general the levelling was favored by a high operating temperature, rapid agitation and high metal content. The principal ingredient effecting the levelling bath was found to be the formic acid. The formaldehyde was used to obtain brightness and has practically no effect on the levelling. Nickel chloride in excess of 8 oz./gal., ammonium compounds, and metallic and organic impurities were all found to have an unfavorable effect on the levelling action of the bath, although the cobalt alone seems to have no effect on levelling. It does add some levelling power to the baths containing formic acid. Purification of the bath by low current density electrolysis and hydrogen peroxide treatment was recommended. Continuous purification is essential. The chromium content was especially critical and must be kept below .0001 oz./gal. Surface measurements of steel before and after plating were made with a Brush Surface Analyzer, taking all measurements at right angles to the polishing direction. The following checks were cited:

Initial RMS of the steel = 20-25
RMS after plating .001" of nickel = 10
RMS after plating .002" of nickel = 5 to 6
RMS after plating .003" of nickel = 3 to 4

The author found no correlation between levelling and brightening action. Some brighteners seem to destroy levelling action, whereas others might produce both levelling and brightening. The physical properties and the corrosion resistance of the deposit corresponded very closely with others from conventional cobalt-nickel solutions. The bath has been tried out in commercial operation and is giving favorable results. The author emphasized that consistent levelling action depended on keeping the solution completely free of organics and at its optimum efficiency at all times.

Surface Contour and Levelling

By A. H. Du Rose, W. P. Karash and K. S. Willson

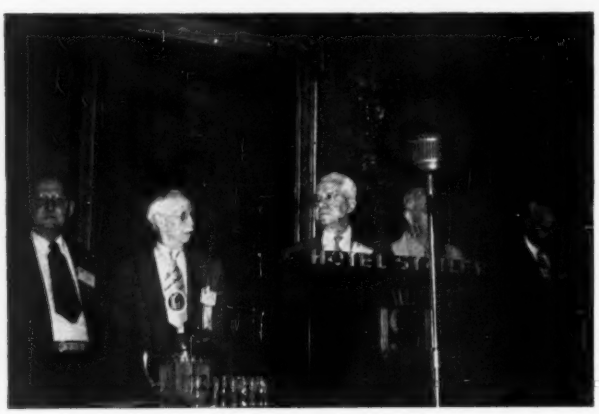
These authors stated that in their opinion all electroplating deposits produce some levelling effect. The relationship between the deposit thickness and the levelling characteristics of various solutions was discussed and methods for evaluating the relative contribution of "cutting-off" and "flowing" of metal in the buffing process were given. Their investigations showed that semi-bright nickel deposits were easiest to buff. They also touched upon the types of polishing mediums used and stated that the medium used must have a higher melting point than the metal being buffed. A brief description of micro-throwing power of copper, zinc and tin deposits was made.

The discussion which followed this paper brought out some interesting information on the levelling effect in both bright and dull zinc barrel plating. The conclusion was that the levelling effect in barrel plating was due primarily to the burnishing action taking place in the barrel, rather than the electrochemical action during deposition. Other listeners discussed the levelling action of approximately 20 various compositions of nickel, copper and cadmium.

Metal Finishing by Abrasive Tumbling

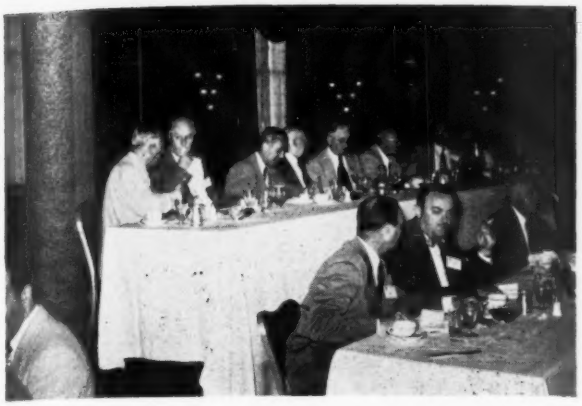
By Hubert M. Goldman

In this paper the author discussed various factors effecting the cutting down techniques in barrel tumbling. The action of the tumbling medium was discussed, as well as the proper loading and speed of the tumbling barrel. The author recommended that total load of the barrel should occupy about 60

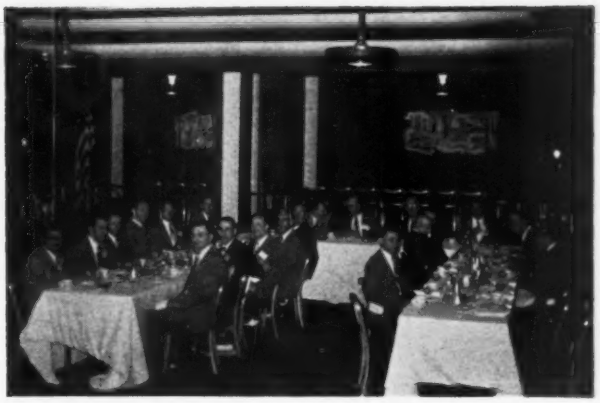


Honoring the Founders of the A. E. S. at the opening of the Convention. (l. to r.) George B. Hogaboom, John Stirling, Charles Cooper, Wm. Schneider, and Horace Smith. Tom Trumbour and E. W. Faint are out of the picture at the left.

Scene at the Fellowship Club Luncheon. Dave Clarin, John Oberender, Fred Gumm, and Dick Crane are recognizable at the speakers table.



Other end of head table at Fellowship Luncheon. Bill Schneider, Bob Leather, Doug MacDermid, George Hogaboom, Tom Trumbour, Al Braun, and Rudy Hazucha are at the top, with Newberry, Camel, and Pellington at second table.



Electrodepositors Technical Society Luncheon. J. Van derGraaf, Walter Pinner, Dr. Wm. Blum, and John Dale are at the head table.

to 70% of the total volume of the barrel. More cutting action would take place at barrel loads under 60% of the barrel capacity, the reason being that the longer length of slide in this case gives the most cutting action. Low speeds of rotation give slow cutting action, and high speeds give rapid cutting action at the risk of marring the parts. About 70 R.P.M. was given as the limit of rotational speed corresponding to a peripheral speed of 100-200 ft./min. The author also touched briefly on the chemicals used in the tumbling operations.

Abrasive Belt Polishing

By E. E. Oathout

The advantages of abrasive belt polishing over commercial polishing methods were discussed, the greatest advantages in belt polishing being the adoptability to contoured work. A number of case histories were presented, showing that higher rate of production and lower finishing cost made possible further use of belts. The various types of equipment available were also discussed. Factors in the selection of proper contact wheel such as the diameter, density and speed were evaluated by the author.

Flat-Polishing Phosphate-Coated Steel Reduces Polishing Costs

By H. J. McVey and V. M. Darsey

The authors discussed how polishing steel in the flat condition followed by a phosphate treatment and lubrication promoted better forming operations. The outstanding advantage of flat polishing, according to these authors, was that changes in design of contoured parts would not effect the polishing operations so much as when the conventional methods of polishing were used. Several examples of actual production savings were given.

Several types of phosphate coatings could be applied after the flat polishing operations depending on the final application of the part. Heavy coatings for wear resistance and lighter coatings as paint bases could be used. The authors brought out that very satisfactory draw-lubricant for phosphate coating parts is an aqueous solution of soap. This material has the advantage of being easily removed prior to finishing operations.

Water Base Buffing Liquids

By E. T. Candee and S. L. Doughty, Jr.

The development of present day buffing compounds was traced and the advantages and disadvantages of bar and paste compounds were discussed. Following this the authors discussed the water-base buffing liquids and classified them into the following groups.

1. Aqueous emulsion with liquid type binders using soluble oils, fatty acids, soaps and abrasives. This type is rarely used today.
2. Non-aqueous binders with dissolved fatty acids. This type is rather hard to clean from the buffed parts. They also constitute a fire hazard and leave dirt on the parts because of the oils used in their makeup.
3. Water emulsion with dissolved solids and insoluble abrasives.
4. Liquid greaseless compounds.

In discussing these materials the authors pointed out the importance of the melting point of the binder used; low melting point binders being used at low speeds and for work where short contact time between the work and the wheel is involved. The higher melting point binders are used on automatic buffing machines for heavy duty work where pressures and speeds are both high and heavy cuts are being made. Another factor discussed was the ratio of abrasive grain to the binder with the higher amount of abrasive grain resulting in sharper cutting. In comparing solid compounds with liquid buffing compounds the following points were brought out: Solid buffing compounds tend to build up on the wheel, which clogs up the air spaces and prevents adequate cooling of the buffing surface. Glazing may also take place, which reduces the amount of cutting performed. Decomposition of the accumulated buffing composition due to the heat generated also creates difficulties. Liquid compositions are claimed to maintain an open or porous polishing head tending to maintain low temperatures at the buffing surfaces. It is also claimed that there is less waste of abrasive and better adherence of abrasive to the wheel. While the aqueous types of compositions are new, the author predicted an important place for them in the mechanical finishing picture.

Reporting and Use of Research Data

By G. M. Cole

In this paper the author discussed methods for reporting of research with specific emphasis on the research being conducted by the AES committees. Various steps of procedure in any research project were listed and instructions given for the issuance of periodic project reports.

Why Pay for Porosity Research?

By W. A. Wesley

In this paper the author gives a clear discussion of the aims of any research project, especially the present projects being carried on by the AES. The need for the AES Research Projects arose because of the inadequate type of research being done in the regular research institutions in the country. The primary object of the AES research projects is to furnish information on basic problems, not necessarily

Chicago Branch Exhibit, which was awarded First Prize in the Branch Exhibits Competition.

The second place Hartford Branch Exhibit.

specific information for overcoming any one particular problem. As an example he cited the work being done on the basic nature of porosity in electrodeposition. Some idea on the future course of AES research projects was outlined and included the following topics:

1. Cyanide vs. sulfate copper solutions—the advantages and disadvantages of each.
2. The effect of organic addition agents on the permeability of deposits.
3. The effect of chromium deposits on the corrodability of the nickel.

A number of other topics were also suggested.

The Use of Radioactive Isotopes for the Determination of Current and Metal Distribution in Electrodeposition

By John Kronsbein

The author discussed a method for utilizing radioactive copper in an acid copper bath to determine the relative distribution of the plated metal on objects of various shapes. Briefly, the method involves plating for a short period of time, then cutting the sample plated part into sections for measuring the radioactivity of each section with a Geiger counter. The method has the advantage of requiring only very thin deposits and very short periods of deposition. Deposits of approximately .00001" in thickness could be measured with a high degree of accuracy. The short plating time reduces to a minimum any possible effects due to cathode polarization. In addition to measuring the radio activity with a Geiger counter, another method for providing recorded data on metal distribution is by using the radio-audiographic technique of photographing the disintegrating copper atoms.

This radioactive technique overcomes the previous objections to microscopic methods, which were that heavy deposits were required for accurate measurement and that a great deal of time was required in cutting up and measuring the specimens. The new method does require extensive apparatus but is extremely easy to operate.

Measurement of Surface Smoothness

By H. L. Kellner

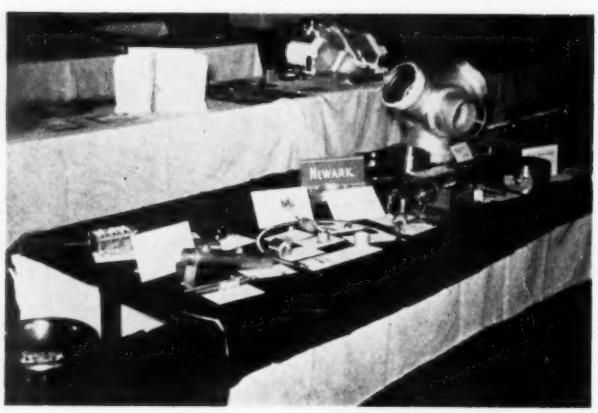
Various methods for measuring the surface contour were discussed. All the methods could be classified into one of the following groups:

1. Microscopic methods
2. Tracer methods
3. Replica methods

In microscopic methods, the author discussed the Schmaltz light-cutting method. This method is limited to rough surfaces of 40 micro inches and over, and to surfaces in which the lines run in a single direction. Another microscopic method was the taper section method, whereby the specimens were mounted in a suitable material and cut on a plane which is angular to the normal surface. This method magnified the surface irregularities and in addition was very time consuming and a very tedious technique.

Then the tracer methods and Brush Analyzer and the Profilometer method were discussed. The author stated that the Profilometer was a rugged, portable instrument, but would not produce a true surface profile curve, whereas the Brush Surface Analyzer would produce a fairly accurate profile of the surface. A factor in all profile measurement was the tendency of the diamond point to flatten out soft metals and thus give erroneous readings. In connection with the tracer methods the author explained the derivation of RMS values.

On replica methods the author mentioned the Faxfilm technique which has the advantage of being non-destructive and allowing accurate visual comparisons, since there is no glare



Newark Branch, which was awarded Third Prize, featured electronic and aircraft plating.

Best Individual Exhibit was submitted by A. Bartman and C. Petrosius of the Chicago Branch.

A pleasant chat between technical sessions is enjoyed by Henry Strow, Henry Mahlstedt, and Walt Cibulskis.

Two of Connecticut's favorite sons seem to be enjoying the clambake; Dr. Walter Meyer and George Hogaboom. The kibitzer is Irv Goldwasser.

from the polished metal surface, as is the case in examining the metal surface in the normal way. A discussion of electron microscope methods was made. This equipment, however, is extremely expensive and requires exact techniques. Finally, the author discussed reflectometers, especially the apparatus proposed by *Gardam*. This has the advantage of requiring only a simply constructed and very inexpensive apparatus which would provide a good auxiliary method for shop control use. The author pointed out that in general there was a relatively poor correlation in the results from the reflectometer and profilometer measurements.

Measurement of Surface Roughness With the Interference Microscope

By Arthur G. Strong and Fielding Ogburn (Paper delivered by Dr. William Blum)

The authors discussed the possible use of the interference microscope, pointing out that the instrument was very good in the range of RMS values of 1 to 15, where most other measuring equipment loses its usefulness. The instrument is not good for very rough surfaces, however. No special preparation of the surface is required and photographic records are easy to make. Areas as small as .009" in diameter can be evaluated. While this instrument has not been widely applied to the measurement of surface roughness, it has important possibilities in this field.

A Self-Regulating Chromium Plating Bath

By J. E. Stareck, H. Mahlstedt, & F. Passal

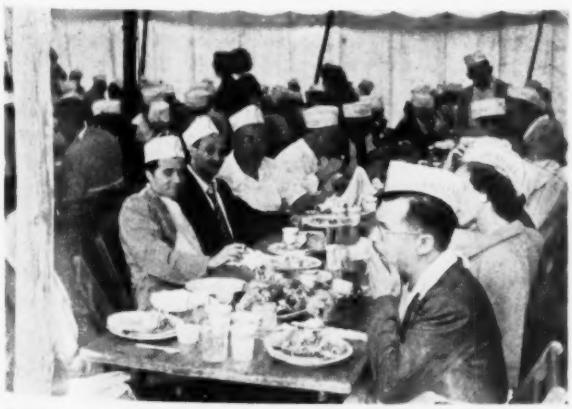
The properties and operating characteristics of a new chrome plating bath were illustrated and described by means of graphs, photomicrographs, and pictures. Two baths were described—one of 21° Baume and the other of 31° Baume, both consisting of chromic acid plus mixed catalysts. The control is automatic with the addition of single addition compounds. The following advantages over the conventional chromium baths were pointed out:

1. Cathode efficiency—the new bath had an efficiency of about 28% as compared to the usual 14% of older types of solutions. This figure was for a 250 gm./l. bath (chromic acid) operating at 6 amps./sq. inch at 130°F.
2. Plating speed—increases up to 75% in plating speed with a 400 gm./l. bath at 150°F.
3. Covering power—much better than regular chrome baths, permitting more pieces per rack and thus higher production.
4. Plating range—much wider plating range for bright deposits, with less treeing in heavier deposits.
5. Hardness—higher Brinell hardness, up to 1250 Brinell.
6. Suitability for barrel plating—because the interruption of current does not affect plating, the solution can be used in barrel plating work.

In addition, the new bath is said to activate passive nickel surfaces, thus reducing staining and irredescent effects on some types of passive nickel deposits. Some special applications include direct plating on cast iron and stainless steel, as well as barrel plating of small parts in bulk.

In operating the bath, a 7% tin-93% lead alloy anode is used in preference to antimonial lead, and air agitation is permissable. Conventional baths which are not highly contaminated can be converted into the new type solution.

One note of caution mentioned was in the plating of deeply recessed parts, which may be etched in the new bath. Stopping off such areas might be necessary in such cases.



Relaxing after a stuffing good time are Irv Goldwasser, George Schore, and John Trumbour. That's leftover lobster on the table.

View of the tent which was covering for over 1200 hungry guests at the clambake held on Wednesday of the Convention.

High Speed Nickel Plating of Curved Stereotypes

By K. L. Koessler and R. R. Sloan
(Paper delivered by Clifford Struyk)

A fluoborate nickel bath containing about 7.5 oz./gal. of free boric acid was described which could deposit .0005" of nickel in 8 minutes. The deposit had a semi-bright finish. The bath is operated at a pH of 3, using rolled depolarized anodes, and a temperature between 94-106°F. Anode efficiency of the bath was almost 100%. In starting the bath, a small amount of peroxide was added to prevent pitting, but after a few days this addition could be dispensed with. Current densities up to 90 amps/sq. ft. can be used at the higher temperature. Operational savings in stereotype work amounted to as much as 75% in labor, 60% in the cost of heating, and 50% in the cost of chemical maintenance. Some stereotypes made in the above fashion had made over 2 million impressions with no appreciable signs of wear.

Measuring Adhesion of Plated Coatings

By Abner Brenner and Virginia D. Morgan

A new method was described for measuring the adhesion of plated coatings of commercial thicknesses. The method involves electroforming a mushroom-shaped projection of cobalt on top of the regular plating. This projection serves as a grip for detaching the coating by means of a chuck and a strong spring. The electroforming projection, about 1/16" in diameter and 1/32" high, can be plated in three to four hours. The force required to detach the coating is measured in pounds per square inch. Results in using this method have indicated that the tensile pull required to separate the coating from the base metal was very close to the actual tensile strength of the base metal. The authors assumed from this that the method was basically correct in principle. Figures given indicated that the test was reproducible within ± 10 — 15%. As yet the effect of the thickness of the coating on the measured adhesion strength is not fully known.

Advances in Electroplating in the Graphic Arts

By E. I. Peters

The author traced the importance and applications of electroplating in this industry and listed a number of solutions which have become more or less standardized for the preparation of nickel and copper electrotypes. He also discussed the tin fluoborate bath and a cobalt-nickel bath which was claimed to be very fast in plating rate and which gave deposits showing low wear and long press life. (The ratio of printing life for the cobalt—nickel to a regular nickel was about 1.57). Also brought out was the fact that fluoborate copper baths are to a large extent replacing the older sulphate acid copper baths because of the higher plating speeds made possible. Reduction in plating time up to 60% was cited. Current densities up to 400 amps/sq. ft. may be used with these fluoborate baths.

Levelling and Smoothing by Electropolishing and Chemical Polishing

By C. L. Faust

The most important point brought out in this paper was that it was not possible to completely classify the visual appearance of a finished surface by any instrumental or numerical system, as the eye would pick up differences not discernable to any of the present-day measuring methods. It is in the micro-roughness range of surface smoothness that present methods fail to correlate completely with visual appearance. Numerous slides were shown pointing out this fact. Whereas electropolishing and chemical polishing considerably improved the visual appearance, this was not always corroborated by mechanical surface roughness measurements. The removal of mechanical debris and better reflectivity of chemical and electrolytically polished surfaces are the outstanding advantages of these methods of surface preparation.

Levelling With PR Current

By G. W. Jernstedt

In this paper the author discussed the various factors involved in PR plating which affected the levelling action during deposition. In most cases the bath composition, insofar as major constituents are concerned, is not critical. Organic matter, however, must be carefully controlled, as it has an important and powerful affect. Higher current densities, above 25 a.s.f., are necessary for levelling action; for the Wes-X copper bath the optimum seems to be between 50-75 a.s.f. Heavier deposits tend to improve levelling, with the optimum thickness somewhere between .001" and .002". Agitation also helps levelling action, and when using PR plating it is best to use the most sacrificial cycle (longest deplating time) for maximum levelling affect.

The economy in purchasing steel with a high quality finish was pointed out. The slight additional cost to purchase #3 finish cold-rolled steel (approximately 1½ cents per lb.) is more than made up by the savings realized in bringing the stock to a smooth enough condition for bright plating.

Some Observations on the Microthrowing Power of Plating Solutions

By C. E. Reinhard

This study was made as a result of some previous work on plating of powdered metal compacts, where it was noticed that the ability of certain baths to deposit metal down into the deeper recesses was much different than that of other baths. The factors which were active in this process were studied further with specimens having specially prepared grooves, so that the thickness of the deposit could be measured microscopically with systematic variations in plating conditions.

The most important point discovered was that acid copper baths have much better microthrowing power than cyanide baths. In the nickel baths, bright nickel seems to have fairly good throwing power, although the low metal nickel baths as well as the high sulfate bath have poor microthrowing power. High current density plating seems to decrease the ability of the baths to deposit metal down into recesses, while higher temperatures increased this ability. pH and the electrode spacing did not seem to have much affect, nor did the base metal. Very little affect could be attributed to the thickness of the deposit. From a consideration of all the above data, the author concluded that microthrowing power seemed to depend primarily on the availability and amount of metal ions at the immediate surface of the metal being plated.

Metal Finishing Developments in Germany 1940-1950

By R. Springer
(Paper read by Dr. Harold Read)

Described the most important work in Germany during this period, which was primarily in the field of pickling and de-rusting for salvage purposes. Chromium plating, using superimposed high frequency alternating current, was tried, but American investigators failed to substantiate the claims made for the method. High acid (10%) chrome baths were also used, permitting current densities up to 3,000 a.s.f., but the efficiency of the bath was very low. Use of fluosilicic acid as a catalyst was tried, but anode filming and control were troublesome.

The Germans found that chrome plate of intermediate hardness, around 750 Vickers, gave longest life to wire drawing dies. Other work cited was silver plating with powdered metal anodes, and alloy silver plating with zinc or tin additions to produce a tarnish-resistant alloy with 10-15% of second metal. Iron plating with addition agents, anodizing and sealing of aluminum alloys, conversion dips for zinc, and brighteners for zinc plating were also mentioned.

Additive Compounds in Electroplating—Part II

By Marvin Rubinstein

In the first article of this series, the author described the four types of additive compounds in common use — wetting agents, addition salts, sequestering agents, and addition agents (brighteners. This article continues with a description of the prevalent theories of how addition agents actually operate in plating solutions.—*Ed.*

BRIGHTNESS of metals is best defined in terms of percentage of light reflected from the surface. It is generally true that small metallic crystals reflect a higher percentage of light than large crystals. Thus, any process limiting the growth of crystals at the cathode — increasing the number of nuclei and small crystals at the expense of large ones — will tend to give brighter deposits. This, however, is only a half answer. Just *how* does an addition agent manage to reduce crystal size, and increase the brightness and hardness of the plate? What exactly are the mechanics of the process? These are very difficult questions to answer. Very little research has been done on the subject, and most of this has been merely the testing of specific brighteners on specific solutions. As in most fields where few facts are available, theories are plentiful.

Electrodeposition Theories

Before attempting to explain the workings of addition agents, it would be wise to give some thought to the actual mechanism of metallic deposition. It was once thought that ions deposited haphazardly at the cathode during electrodeposition. More recently, however, three more realistic theories have evolved. The first postulates that the atoms are discharged not at the cathode but in a layer (one atom in thickness) in the cathode film. When this layer becomes supersaturated, the entire layer deposits as a layer of crystals. A second theory states that the atoms are deposited haphazardly on the cathode, remaining in a dispersed or adsorbed condition. At a given energy state, the atoms re-orient themselves into a more regular pattern. According to the latest theory, the atoms are deposited singly, but certainly not haphazardly. Neutralization of a given ion (deposition) normally takes place on that point on the cathode surface where the lowest discharge potential is required, and the least energy is used.

Since most electrodeposited metals crystallize isometrically, i.e. as cubes, normal deposition would tend to complete these crystals. Since smaller crystals require more free energy than large ones, normal deposition would tend to deposit large crystals. Regardless of the actual mechanism of deposition, the above seems to be the normal situation. Polarization, however, apparently changes the norm, provides for greater interchange at the cathode, and results in a large increase of formation of crystal nucleii. Thus, to achieve brighter plating, one should aim at increasing the cathode polarization. This can be done in the following ways:

1. Increase current density
2. Decrease agitation
3. Decrease temperature
4. Dilute solution
5. Increase solution viscosity
6. Add common ion to decrease dissociation
7. Add addition agents

The plating of commercially useful deposits by means of an appreciable increase of current density, however, is often dependent on increased agitation, temperature, and bath concentration, all of which defeat the original purpose. Increasing viscosity is often difficult, and the common ion effect is somewhat limited. Thus, it often results that the use of addition agents is the only practical method for increasing polarization and consequently brightness. In considering theories as to just how this is done, the mechanics of electrodeposition should be kept in mind.

Reducing Menstruum Theory

One of the earliest efforts to classify and coordinate the activities of addition agents was made by an electrochemist, *Edward F. Kern*. He postulated what is known as the "reducing menstruum" theory. According to Kern, the function of an addition agent is to maintain a reducing menstruum around the cathode. A reducing menstruum may be defined as a solvent film which tends to decrease the positive character of the ions in solution. Since, in a plating bath, the positively charged metallic ions are reduced at the cathode to a metal having no charge, any cathode film tending to make this change easier should have a brightening affect. As an example, in the silver cyanide bath the metallic silver ions have a charge of plus one. At the

cathode these ions are reduced i.e. become more negative, and neutral silver metal is deposited. If Kern's theory holds, a brightener like ammonium thiosulfate must further this reducing process to be affective.

Kern supported this theory with a number of facts. He had noticed, for example, that most brighteners were organic compounds, and that large numbers of these belonged to the same family, the benzene ring compounds. Also, the most effective brighteners were those benzene ring compounds containing hydroxyl (OH^-) and amine (NH^+) radicals fastened to the benzene ring. The greater the molecular weight of the compounds, that is the more amino and hydroxyl radicals it contained, the better it served as an addition agent. The more closely grouped these radicals appeared on the benzene ring, the better was the addition agent.

One of the rules of organic chemistry states: "The best reducing compounds of the benzene ring series and those which more readily precipitate metals from their solutions, are those compounds containing the largest number of hydroxyl and amino radicals and those compounds in which these radicals are most closely grouped." Thus, putting two and two together, it seemed logical that the compounds which are the best reducing agents are also the best addition agents.

In support of this theory, Kern also pointed out that the densest deposits come from cyanide solutions where the anions are not too oxidizing. Oxidation and reduction are reverse processes. The least dense deposits, on the other hand, come from strongly oxidizing media like nitrate and chlorate baths. Furthermore, electrolytes containing alkaline earth salts generally give denser, smoother, less crystalline deposits. Examples are commonplace: sodium chloride (salt) in nickel baths; sodium, potassium, or magnesium salts in iron solutions; sodium cyanide in acid copper baths. All these salts help maintain a reducing area around the cathode film.

It is interesting to view this theory in relation to the electromotive series of metals. Those metals which are above hydrogen in the series are strongly electronegative, (tend to dissolve in the solution rather than deposit from it), and are thus not easily reduced. These metals, e.g. lead, tin, chromium, and zinc tend to give course, rough deposits, particularly in the presence of free acids and oxidizing compounds. Furthermore, these are the metals most easily improved with addition agents, since there is much more room for improvement. Metals like copper, silver and gold, being below hydrogen in the series and thus more easily reduced, tend to give tougher, denser deposits, are less easily affected by addition agents. Roughness in these metals is more apt to be caused by impurities near to or below the main metal in the series.

While the reducing menstruum theory represents a fine attempt to bring order out of chaos in the field of addition agents, it unfortunately leaves too many questions unanswered to be considered reliable. No explanation has been made of the function of metallic salts as brighteners. What above inorganic crystalloids acidic in nature and other oxidizing or neutral additional agents? How do they work? The explanation that they form reducing agents in the cathode film is too weak an answer. Most important, why are addition agents always so specific? Why will a given agent serve as a brightener for a given bath and not work for a similar bath composed of the same salts of another metal, operated at the same acidity, temperature, current, etc.? Until these are answered, the reducing menstruum theory may serve as a partial guide to the choice of an addition agent but not as a sound, all-inclusive explanation of why addition agents work as they do.

Adsorption Theory

First voiced by Professor *Wilder D. Bancroft* of Cornell University, the adsorption theory was later expanded and publicized by *William Blum* of the U. S. Bureau of Standards. This theory postulates that:

(a) addition agents are colloids or form colloids in the solution as a whole or in the cathode film;
(b) these colloids to be effective must be positively charged and be attracted to the cathode by the current; and
(c) they must be adsorbed by the precipitating metal in such amounts as to cut down the size of the crystals formed without giving rise to pulverulent crystals.

The mechanism for cutting down the crystal size is simple. The colloidal particles are adsorbed into the crystal latices. There, they form a non-conducting blanket, which prevents further growth of these particular crystals. Any metallic ions must now form new crystal nuclei in order to plate out. Thus, there is a constant interference of crystalline growth. The plate, consisting of many small rather than a few large crystals, is harder, smoother, finer grained, brighter. In addition, the increased resistance of the non-conducting colloidal matter requires considerably greater voltages. Addition agents often require voltage increases of as much as forty per cent.

Effectiveness of an addition agent, according to the adsorption theory, will vary with the speed of passage of the colloid toward the cathode and with the extent of the adsorption. Transition speed varies with the nature of the colloid, temperature of the solution, acidity, and the nature of the other ions in the solution. Extent of adsorption depends on the nature of the colloid and the nature of the metal being plated. This last can be determined non-electrolytically for each individual metal. Another factor which may enter into the results is the possible adsorption of metallic ions by the colloidal particles themselves. Whether this is either desirable or necessary is still a matter of conjecture.

Many facts tend to bear out at least the partial validity of the adsorption theory. A very large percentage of successful addition agents form colloids in plating baths, particularly in basic solutions. Actual microscopic studies of colloids have shown that they do migrate with the current. Those positively charged migrate to the cathode and are most generally used as addition agents. Neutral and negatively colloids also exist but are for the most part not useful. Colloid concentration in the cathode film is appreciably larger than in the main body of solution.

The use of metallic addition agents can be explained by this theory. Cathode films are invariably more basic than the rest of the solution. Even acid solutions some-

times have cathode films with an alkaline pH. It is quite possible that metallic compounds and some inorganic crystalloids hydrolyze in the cathode film to form colloidal compounds. This has definitely been shown to be true with amphoteric metals like tin and aluminum. Though unlikely, it is at least theoretically possible for other metallic compounds.

Professor *F. C. Mathers* of the University of Indiana studied the adsorption of numerous oils on metallic surfaces in a non-electrolytic state. His results fit in nicely with the adsorption theory. He found that the more readily an oil is adsorbed at a metallic surface, the more effective it tends to be as an addition agent. He tested metals to find their relating adsorbing powers and listed them in order of decreasing adsorption:

$$Pb \rightarrow Sb \rightarrow Cu \rightarrow Cd \rightarrow Zn \rightarrow Fe \rightarrow Sn \rightarrow Ag$$

This listing roughly corresponded to the increased difficulty encountered in finding effective brighteners for decreasing the per cent of roughness and treeing in the plate. Finally he found that acids tend to decrease the adsorption of oils by metallic surfaces. Muriatic acid is particularly bad in this respect, being worse than acetic acid, which in turn is much worse than sulfuric. This may explain the difficulty in obtaining good brighteners for straight nickel chloride baths. It also may indicate why tin sulfate baths give smooth deposits, while tin chloride baths give a loose, crystalline plate. It provides an explanation for the more dense deposition from cyanide and alkaline baths.

Finally, there is plenty of evidence that colloidal material is occluded in the deposits, whenever addition agents are used. The larger the concentration of addition agent, the larger is the % found in the plate.

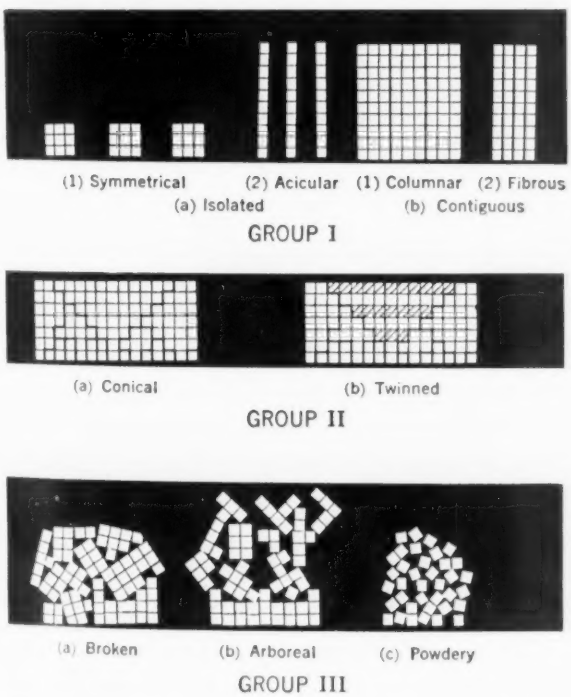


Figure 1. Diagramatic representation of principle crystal types. Rough crystalline deposits result when crystals are allowed to grow large, as in Group 1. Most commercial dull plating has a conical structure, as in Group 2a. Twinned deposits, Group 2b, are semi-bright. A broken structure as in Group 3a gives really bright plating. Arboreal deposits, Group 3b, results in treeing, while burnt deposits have a powdery structure, Group 3c. (From Principles of Electroplating and Electroforming, 3/e, by Blum & Hogaboom. 1949 McGraw-Hill Book Co.)

All of these facts tend to substantiate the adsorption theory; it should be remembered, however, that these same facts are not necessarily inconsistent with other theories.

On the debit side of the ledger, many inexplicables crop up in discussing the validity of the adsorption theory. Firstly, all colloids are not necessarily good addition agents. Silver nitrate solutions containing pyrogallol, an obvious colloid, give fluffy, loose deposits. On the other hand, non-colloids like tartaric and metaphosphoric acids are extremely valuable. Though the conversion of these compounds to a colloidal state is theoretically possible, as previously stated, it seems unlikely. There has never been any evidence of such a change; the compounds have never been isolated in a colloidal state.

Three other interesting facts arise. When both negatively and positively charged colloids exist in solution, they do not coagulate; rather, they repel each other due to materials adsorbed on the surface. This would tend to indicate a more complex form of compound in the solution and a more complex mechanism of deposition. Also indicative of this is the fact that iodide in a lead bath causes spongy deposits. Since the iodide is negatively charged, it could not get to the cathode on its own. Thirdly, a direct relationship has been found to exist between the amount of metal plated and the consumption of organics in the bath. Since adsorption is independent of current passed, there would seem to be some electrochemical phenomenon in the occlusion of addition agent in the cathode.

Finally, there is the stumbling block that all addition agent theories must overcome. Why are addition agents so specific? If reaction at the cathode were independent of any connection with or combination with the cation, any addition agent would be equally effective for all salts of a metal. This is not so. Glue is good in lead fluosilicate and lead fluborate baths. In perchlorate, acetate, and sulfamate lead baths, it just doesn't work.

The Complex Theory

A somewhat more foolproof theory is the complex theory of *F. C. Mathers*. Keeping foremost in mind the extremely specific nature of many addition agents, Mathers postulated that the addition agents form complex cations in the bath by combining with the metal ion and in some cases the anion radical and water molecules. These complex cations are carried by the current and deposited on the cathode, interfere with normal crystal growth, and create a fine grained, bright deposit.

In applying his long experience with addition agents, Professor Mathers may have taken the following into account:

1. Analyses of deposits have shown them to contain many of the materials present in the baths. Certain types of "explosive antimony" deposits have been found to contain about 5 per cent antimony chloride. Traces of the perchlorate radical occur in deposits from bismuth perchlorate baths. Tartrates and as much as one per cent of iron were found in deposits from a silver bath containing silver nitrate, ferric nitrate, nitric acid, and tartaric acid. Since iron and silver are too far apart electrochemically for co-deposition, another explanation is needed: the complex theory

fills the bill. Also, the organics found in the cathode deposit increase with older solution.

2. Complex cations such as gelatine plus zinc do exist. Many proteins have the property of forming complexes with metallic ions; a close connection seems to exist between value as an addition agent and ability to form complexes. (There is, however, no proof that those compounds forming the most complexes are the best addition agents.) There is a possibility that if we list addition agents in their order of protective value to sols (i.e. their effectiveness in keeping metal from precipitating from colloidal complexes), the series would correspond to their effectiveness as addition agents. It is likely that this series is the same or similar to the one referred to earlier in the article of materials listed in their order of adsorbability.

3. Metals most easily affected by addition agents are often those which most easily form complexes. Antimony, affected by many organics, tends towards complexes. Silver, affected by few, doesn't. A list in order of ability to form complexes would be similar to the list given earlier showing decreasing adsorption. There is some evidence that potassium forms complexes more easily than sodium, which would account for its preferred use in silver and bright copper baths.

4. As previously noted in dealing with the shortcomings of the colloidal theory, there are several indications that the transfer of addition agents to the cathode and their deposition thereon is a phenomenon of an electrochemical nature, rather than pure adsorption. This is strengthened by the fact that the weight of addition agent in the cathode is approximately proportionate to the amount of current passed.

All of these facts had already been observed before the complex theory came into being. It was a number of years later that three Japanese investigators did some fine research on the mechanics of addition agents in copper and silver baths. Their results did much to uphold the validity of this theory for at least certain types of addition agents. Using glycocoll (G) as an addition agent in an acid copper bath, *Fuseya*, *Murata* and *Nagano* made some extremely interesting observations. By means of analysis of the cathode and precise ion transfer measurement, they determined that complex ions similar to $(CuG_4)^{++}$ are formed and that the color of the solution varies with the degree of complex formation. They also found that:

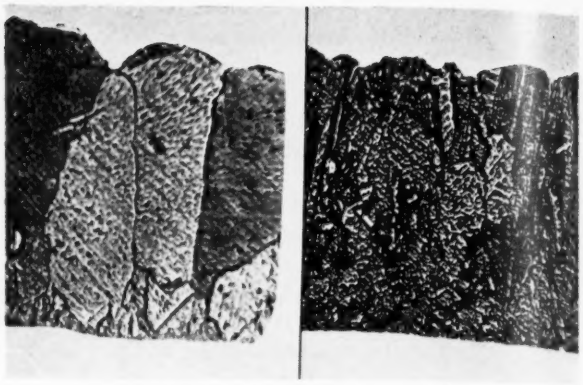
a. An increase in the addition agent concentration increases the degree of complex formation, the amount of addition agent in the deposit, and the fineness of the deposit. (However, the rate of increase becomes less with higher concentrations.)

   Also, ratio of $\frac{AA}{Cu}$ in the deposit is greater than in the solution for normal concentrations of addition agent. (Reversed for very high concentrations.) Possible explanation: Complex salts dissociate more than $CuSO_4$ does. Deposition and deposit compositions depend, not on the concentration of the complex or the copper sulfate, but on the concentration of the dissociation products. Increased concentration increases dissociation through common ion effect.

b. Increased current density increases weight of addition agent in deposit. (Here also, the rate of increase becomes progressively less.) Possible explanation: Greater cathode polarization needed to deposit complex ions as compared to copper ions. Increased current density increases cathodic polarization. Ultimately, the rate decreases, due to depletion of addition agent in the cathode film, since the weight of agent in the cathode is greater than in the solution. Ion migration-deposition equilibrium is reached at smaller concentration of complex ions near cathode, i.e. at lower current densities. Cathode agitation partially overcomes this difficulty.

c. Increased temperature decreases the amount of addition agent in deposit. Possible explanation: Heats of formation of complex salts are generally positive. Therefor the degree of formation of complex ions is less.

d. An increase in the acid content of the bath decreases the quantity of addition agent in the deposit. Possible explanation: With large additions of acid, complex formation becomes less, since glycollol probably converts to glycol sulfate (amphoteric). (Note the fact that most if not all addition agents decompose in the highly acid chrome bath.)



a b

Figure 2. Showing how increasing current density gives finer crystal structure and thus brighter deposits.
(a) 37 A.S.F. (b) 93 A.S.F.
(From Principles of Electroplating & Electroforming, 3 e, by Blum & Hogaboom. 1949. McGraw-Hill Book Co.)

All in all, the indications are that the complex theory holds up better than any other. For most types of addition agents in common use, it checks all the way down the line. As an explanation of why alloys tend to be brighter than single metals, it is only partially satisfactory. For certain inorganics which don't seem to appear in the deposit (e.g. silicic acid in zinc baths), this explanation falls down. Similarly, in a few cases where the addition agent decreases the polarization (e.g. goulac in acid copper and carbon disulfide in silver baths), the complex theory is inadequate or completely false. However, the theory works in enough cases to indicate that the exceptions are special cases operating under special mechanisms. Theories for these individual cases will be discussed later.

Hunt's Theory

One of the more recent theories is that fathered by another electrochemist, *L. B. Hunt*. He states: "The structure of the electrodeposited metal is determined by

a b

Figure 3. Increased temperature gives coarser crystalline deposits, thus detracting from brightness. (a) 77°F. (b) 104°F. (From Principles of Electroplating and Electroforming, 3/e, by Blum & Hogaboom. 1949. McGraw-Hill Book Co.)

the ratio of the metal ion concentration to the concentration of the remaining constituents of the film." If this ratio is high, coarse, crystalline deposits are obtained. A low ratio, showing high concentration of inert particles, produces interference with deposition and thus the formation of more nucleii.

Inert particles include undissociated molecules, water dipoles, complex cations, and colloidal bodies. (For significant effect, colloidal bodies must be positively charged.) These bodies may or may not be included in the cathode. Where included, the precise mechanism of the cohesion of the particles is unknown. Possibilities include adhesion, co-deposition, secondary deposition, and mechanical inclusion (inclusion in pores, cracks, and interstices). Naturally, more rapid deposition decreases the chances of inert bodies escaping back to the solution, thereby increasing their quantity in the cathode.

Since Hunt's theory is in a sense a corollary of both the adsorption and complex theories and gives additional rather than contradictory possibilities, not much discussion will be given to it. Where these other theories hold up, Hunt's theory is also valid. In addition, it provides a plausible explanation for the special cases where the complex theory seems insufficient.

In passing, it might be well to mention two unpublicized ancestors of Hunt's theory, both similar in nature. The first argued that the function of colloids was to act as an elastic cathode membrane, thus keeping the ions from bunching at the cathode before plating out. Here, the theorist noted that one part by volume of glue in eight million parts acid copper solution serves as an effective brightener. Since colloidal molecules are generally about 1,000 times as large as crystalloidal molecules, he reasoned that there was one molecule of glue to about eight billion molecules of copper sulfate. However, colloids have an extremely pronounced tendency to swell in solution. One molecule of gelatin to 60,000 of water can be made to produce a solid jelly. An analogy can be made between a quantity of dry colloid and a box of balloons: inflate the balloons and note their relative volume as compared to the unopened box. Thus, even a tiny per cent of colloid in a bath, by achieving a swollen state, can effectively blanket the cathode. The second theory expanded this idea to cover metallic addition agents (non-colloidal). It was noted that copper nitrate added to a silver plaitng solution decreased grain size. Inferred from this was the idea that the much larger copper ions decreased the number of silver ions at the cathode and also effectively blanketed those there. Combining this idea with co-deposition gives a possible theory for the smaller crystal size achieved through alloy deposition.

Surface Tension Theory

In 1919, *Anson G. Betts* evolved a fascinating though minor theory of bright plating. He stated that each layer of metal, as it is built up at the cathode, obeys the laws of surface tension. According to this law, flat or extremely concave surfaces are at a more stable energy state than sharply curved or bent surfaces. Thus there is always a tendency for the former to gain at the expense of the latter. Such is the situation in the formation of rain. Millions of tiny moisture droplets exist in the clouds. The smaller droplets having a lower surface tension tend to vaporize and grow smaller. The larger, more concave drops gain in size from the supersaturated vapor. When heavy and large enough, they fall as rain.

Betts argued that the situation at the cathode surface was similar. High surface tension metals, i.e. the strong, hard metals like copper, give the smoothest brightest deposits. They do this because, as each monomolecular layer deposits, it re-arranges itself, the flat or most concave surfaces gaining at the expense of the bumps, nodules, trees, and other sharply curved projections. Weak, low surface tension metals like lead and tin give the roughest deposits, since there is little tendency towards this rearrangement. At high current densities, however, there is less time for the play of surface phenomenon, resulting in treeing and rougher deposits. Naturally, the same condition exists at the anode, as indicated by the fact that lead anodes are smoother when glue is added to a lead plating bath.

According to this theory, addition agents serve to give brighter deposits by increasing the hardness and toughness of the deposited metal, giving a deposit of extremely high surface tension. All of this sounds plausible enough, but an important question remains unanswered. How does the addition agent act in creating a tougher, stronger deposit? For this answer, one must return to the other theories.

Minor Theories and Special Cases

The function of certain inorganic addition agents

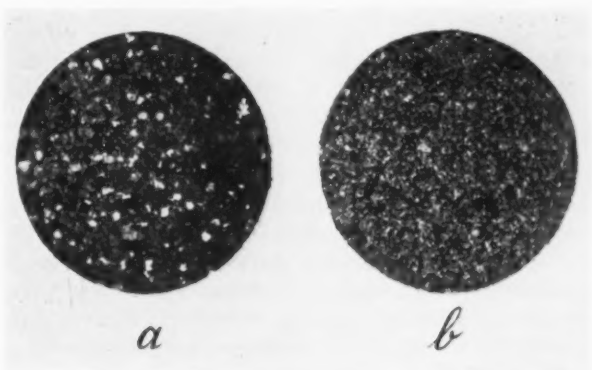


Figure 4. Showing difference between deposits from baths without additoin agents and from those where brighteners have been added.
(a) Deposit obtained from 0.1M $CuSO_4$, 1.25M H_2SO_4 solution at 30°C. and 1 amp/sq. dm.
(b) Deposit obtained under same conditions as (a), but NH_4NO_3 added (0.1N).

may be explained in terms of simultaneous reduction. A typical case is that of ammonium nitrate used as an addition agent in acid copper baths. It is thought that in this case both the Cu^{++} and the NO_3^- ions are reduced simultaneously at the cathode, the Cu^{++} forming metallic copper and the NO_3^- giving rise to soluble reduction products. These nitrogen products adhere only momentarily to the cathode, long enough to interfere with crystal growth, but not long enough to be included in the deposit. This reaction also allows for higher current densities, since hydrogen evolution is replaced by NO_3^- reduction.

This theory is also applicable for sodium thiosulfate in copper cyanide and silver cyanide baths, and for carbon disulfide, cyanates, and ammonium hydroxide in silver baths. In all these cases, the addition agent is non-colloidal, is not included in the deposit. Some are also typical in that polarization is decreased with their use. Where some time elapses between adding addition agent and its effect, it is probable that the products reduced at that cathode must previously be formed at the anode through oxidation. Major weakness of the theory is its failure to explain the mechanism by which interfering materials like NO_3^- reach the cathode.

Secondary deposition provides the basis for another theory. Here, the addition agent also forms complex ions. However, rather than co-depositing (as in the complex theory), a primary product plates out, in turn reducing the metallic portion of the complex ion as a secondary product. The action is similar to the reduction of silver from the silver sodium cyanide complex. $NaAg(Cn)_2$ ionizes to Na^+ plus $Ag(Cn)_2^-$. The primary deposition is that of sodium. This in turn reduces the $Ag(Cn)_2^-$ ion, and silver is deposited as a secondary reduction product. Secondary silver is fine, crystalline, and smooth. Primary silver, as in acid solutions, is coarse. Postulating a $NaAg(Colloid)_2$, a similar mechanism is possible. Co-deposition or a combination of the two processes is more likely, however.

A theory based on the clarifying action of addition agents has also gained some adherents. This is a variation of the colloid theory. In this story, rather than being adsorbed, the positively charged colloids are deposited at the cathode. However, they will only deposit at points where the current density is excessively high. This only occurs at points on the cathode where positively charged dirt or impurity particles have been deposited. Lacking addition agents in the solution, these points would give rise to bumps, pits, and nodules. The colloidal addition agent, however, provides a non-conductive blanket for these raised points, until the rest of the plate catches up and the deposit is again smooth. At such a time, the impurity and colloid together are covered by subsequent plating. According to this theory, addition agents are only effective in solutions that are not clean. While it can readily be admitted that addition agents serve best in such solutions and that the mechanism described probably does take place, it is doubtful that clarifying action is responsible for all the advantages addition agents have to offer. As far as is known, addition agents are of some advantage even in constantly filtered solutions.

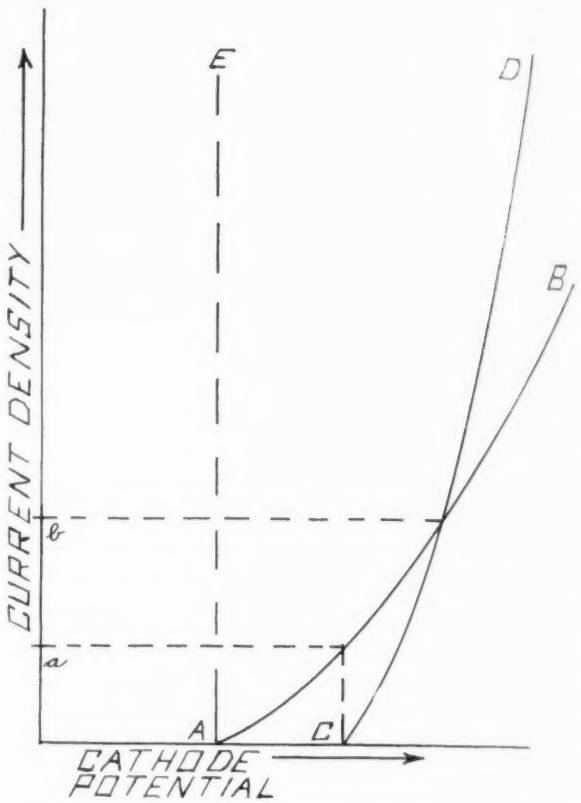


Figure 5. Possible graphic explanation of effect of addition agents such as nitrates in acid copper baths, or thiosulphates in cyanide copper baths, where brightener is not included in deposits. Line AB represents cathode potential: current density relationship for a single metal in solution. CD represents same ratio for the solution when a reducible anion is also present in the bath. Above current density (a), both substances would be reduced. Where the cathode potential for the reduction of the extra anion increases at a greater rate with current density than does that of the metal ion alone, there will be a decrease in the cathode polarization of the metal at a current density above (b). (Cathode polarization can be read on this graph as the difference between the cathode potential for a given current density and the static potential for that current shown on line AE.)

(Courtesy of Electrochemical Society—Transactions Vol. 68)

Another theory states that addition agents work by reducing surface tension in the cathode film, i.e. as wetting agents. Though possibly a contributing factor, this seems unlikely. A wetting agent like turkey red oil, for example, doesn't work in acid zinc solutions.

A variation of the complex theory states that crystal growth is retarded because the velocity of separation of the metal from the complex is small. Co-deposition seems more likely, but this may superimpose, as may adsorption or mechanical inclusion. Still another variation allows for the co-deposition of basic salts.

Finally, some explanation must be given for the fact that alloys are generally brighter and finer grained than either of the component metals plated individually. When additional organics are included, the complex theory could very well work here. In the absence of organics, two other explanations are possible. Ions of each metal may have an interference effect on regular deposition of the other constituent, thus hindering the growth of large crystals. Also, there is the possibility of the formation of a new metallic phase, such as solid solution of the two constituents, immediately prior to deposition. This has never been adequately explored.

(Concluded on page 58)

Preparing Zinc Base Die Castings for Electroplating

By Joseph Haas, *Industrial Engineer*

THIS article was originally intended as a supplement to the author's previous article on "A Critical Survey of Plating Practice for Zinc-Base Die-Castings" (*Metal Finishing*, August 1949). However, an article by *MacMullen* and *Ozar*, which appeared in the April 1949 issue of the same journal and which resulted in various letters to the editor expressing differences in opinion as to the merits of silicates in metal cleaning baths, has caused the author to revise the original draft and to include supplemental results obtained in experimental and production tests which will throw additional light on this controversial subject.

In the paper by *MacMullen* and *Ozar*, the following statement was made: "cathodic and anodic films are formed when such (silicated cleaning) solutions are electrolyzed. Both of these films are readily soluble in subsequent acid dips and therefore present no plating problem." These writers also inferred that it is immaterial whether cathodic or anodic cleaning is used with cleaners, and that equally good results are obtained with either method.

My experience with both experimental and plating room production completely contradict the first statement by MacMullen and Ozar. The statement that silicated cleaners present no plating problems is true only in newly made cleaning baths. As the bath is used for some time, it was observed that the clearness of the product diminished. In making up a new cleaning bath, the writer has found that the following steps should be taken to insure good results:

1. The cleaner bath should be boiled for several minutes.
2. The bath should be electrolyzed for 15-30 minutes before processing regular production work.

In regard to the second point that it is immaterial whether cathodic or anodic cleaning is used for zinc die castings, the writer wishes to call attention to the paper by *Petrocelli* and *Phillips* (Trans. Electrochemical Society, Vol. 85, 1944, p. 257) and to the article by *Anderson* and *Reinhard* (A.E.S. Monthly Review). In the latter paper, it was reported that when cathodic cleaning was discontinued the rejects dropped in one case from 50% to 0.1%, and in another case from 20-30% to 0.5-1.0%.

In addition, the writer has made a continuing survey of the practice followed in production plants and has found that anodic cleaning is the predominating practice. In some plants where cathodic cleaning was being done, the writer's recommendation to change to anodic cleaning showed improved results. I therefore came to the conclusion that anodic cleaning was the proper procedure for cleaning zinc-base die-castings, and all the plant experiments reported hereafter were confined to anodic cleaning.

Method of Testing

For the purpose of this article, two classes of alloys were used: regular zinc-base die-cast alloys, and articles of zinc cast in permanent molds gravity fed (erroneously referred to often as slush castings). These latter alloys may contain up to 8% of aluminum.

The cleansers used were those of three different manufacturers of cleaners: all three were in general use in industry, and recommended for cleaning zinc alloys for plating.

In each case, (leaving out preliminary finishing and cleaning methods), the procedure was as follows:—

1—Electric clean	anodic 6 volts; ½-1 minute; 160°-180°F.
2—Rinse	
3—Rinse	
4.—Acid	1% hydrochloric acid 5-15 secs.
5—Rinse	
6—Rinse	
7—Electroplate	

The above was repeated with sulphuric acid as an acid dip. In all cases after plating, castings were heated in an oven maintained at 300°F. for periods of 15 minutes to one (1) hour. Results were variable with both acids; some pieces blistered, others were perfect. Parallel samples from the same run, not subjected to the heat treatment, but buffed and colored showed no signs of blistering, but when subsequently placed in the oven and subjected to heat, the percentage of blistering was the same. The order of blistering could be classified as follows:

1—Small straight-line-shaped zinc-base die-castings and zinc alloy castings — very little blistering; could be considered good results.
2—Medium sized articles with contours and recesses — increased blistering, but still could be considered fair.
3—Large sized articles of more complicated shape — still greater blistering; classed as bad.
4—Large zinc alloy castings — very bad blistering.

Considerable of these observations had been made

during the preparation of the article "A Critical Survey of Plating Practice for Zinc Base Die Castings" but were omitted, so as not to interfere with the main purpose of that article, although briefly alluded to.

The experiments that form the basis of this article were made as a confirmation and check with the purpose of arriving at as fool-proof a cleaning and preplating treatment cycle as possible.

A fairly definite conclusion had been reached as to the cause of the varying results of the electrodeposited items. The conclusion was that in electric cleaning a surface film was formed on the articles by the action of cleaners in use several hours, as against cleaners newly made up, that was not soluble in hydrochloric or sulphuric acid, and that this surface film could only be of a silicious nature. Therefore hydrofluoric acid (1%) was substituted as the acid dip. The writer does not claim originality in the use of hydrofluoric acid. One of the manufacturers of cleaners recommended it as an alternate acid dip, but did not stress it as being of any particular advantage. Also *C. F. Nixon*, in "Electroplating Zinc Base Die Castings," (*Metal Finishing*, March 1947, page 60) also referred to hydrofluoric acid as an alternate dip, but classified its use as hazardous.

Production runs with hydrofluoric acid from which samples were tested as heretofore described, were in all cases 100% perfect, except in the cases #3, which in this case could be considered as good, and #4 which had to be classified as bad.

To further improve the results, additional experiments were performed, following a procedure (see *Letter to Editor*, January 1948, page 115 by *Dr. Walter R. Meyer*) as outlined:

1—Electric clean	anodic 6 volts; ½-1 minute; 160°-180°F.
2—Rinse	
3—Rinse	
4—Acid dip	1% hydrofluoric acid 5-15 secs.
5—Rinse	
6—Rinse	
7—Immerse in strong sodium zincate solution	3-5 secs.; cold.
8—Rinse	Violently agitated water
9—Spray rinse	optional—but desirable
10—Rinse	
11—Electroplating	

Production runs, using the above cleaning and treatment cycle, and tested by heating, were in this case all 100% perfect. Repeated checks with manufacturers, now covering months of operation, has proven the reliability of the above cycle for preparing zinc die-castings, and zinc cast alloys for electro-plating.

There is a final word of caution that the writer would like to emphasize, and that is the temperature of the electrocleaner in the final preparatory cycle. The temperature should definitely be kept between the limits specified. Too high a temperature will lead to discolored articles, and while there are many that contend that such discoloration is immaterial, the writer's experience has been otherwise.

ADDITIVE COMPOUNDS IN ELECTROPLATING

(*Concluded from page* 56)

Generalizations and Conclusions

The author, in attempting to summarize the work done in this field, neither swears by or vehemently denies any of the aforementioned theories. Obviously, the only conclusion to be reached is that the evidence is inconclusive, and that much more controlled experimentation is needed. However, any adequate theory must explain the following:

1. Usual inclusion in the deposit of addition agent or derived substance. Reason for exceptions.
2. Effect upon crystal structure and properties of deposit.
3. Effect on cathode polarization, throwing power, conductivity.
4. Increased allowable current density.

Whichever theory one holds to, if any, it must be admitted that a good addition agent should have these properties:

1. It should be inexpensive.
2. It should be easily analyzed and controlled.
3. It should not react chemically with the solution to form ineffective compounds.
4. It should not be oxidized at the anode or reduced at the cathode to form ineffective compounds.
5. It should be equally effective over a wide range of construction, temperature, and pH.
6. It should not be excessively included in the deposit for best mechanical results.

In the next article of this series, the author will cover the theory of operation of addition salts, sequestering agents, and wetting agents. He will also discuss some other pertinent factors in the use of additive compounds.

In a recent communication, *Mr. George B. Hogaboom* helped fill a gap in the history of addition salts. He pointed out that on December 17, 1878, *Dr. Edward Weston* was granted U.S. Patent No. 211,071 for the addition of boric acid to nickel solution.

He also referred to the fact that concentration of chemicals in a bath had been given in terms of "percentage" and questioned the precise meaning of this often misused term. The author has found it most convenient for general work around the plating room to express concentrations in ounces per gallon or grams per liter. These expressions are not open to confusion. However, this series of articles is a summary of the work done by others in the field. Where they have used "percentages," the author has had the unpleasant choice of either using their terminology or guessing the exact meaning and converting it to more sensible terms. In general, however, where "percentages" come up in this series, the following rule may be used: For solid materials added to a bath, percentage by weight is used, i.e. the weight of the salt added expressed as a percentage of the *total weight of the solution* (not of the weight of the water solvent). For liquid materials added to the bath, percentage by volume is used, i.e. the volume of liquid added expressed as a percentage of the total volume of the solution (volume of bath plus volume of added liquid).

All Our Yesterdays—Part XIV

By Frederick A. Lowenheim

WHEN you opened your newspaper on a morning in January, 1916, you read that striking steel workers in Youngstown, Ohio rioted and caused almost a million dollars' damage to the business section, burning and looting; that followers of *Pancho Villa* took eighteen American mining officials and employees off a train in a small Mexican town and shot them. prohibition went into effect in six more sovereign states, the inhabitants of which presumably knew what they were doing. The Youngstown strike was settled by a ten per cent increase in wages, and the U. S. government promptly demanded capture and punishment of the guilty Mexicans — a demand which President *Carranza* accepted, but which he was to find difficult to carry out. The Supreme Court held that the new income tax law was constitutional.

Neutrality was becoming more and more of a strain on the tempers and diplomatic ability of our State Department, which was spending a major portion of its time writing indignant notes to both sides in the European war protesting invasion of our rights. A minor victory was won when Germany admitted her liability and offered indemnity in the *Lusitania* case. In March *Newton D. Baker* became Secretary of War after *Garrison* had resigned in disagreement over our policies.

The war in Europe was beginning to have an impact on economic conditions in the U. S., which was noted in the trade journals of the metal industries; from Newark, N. J., a correspondent wrote:

"No trouble to get orders, but very difficult to get materials with which to fill them; some trouble in shipping goods because of the congested transportation facilities, and prices of materials ranging from half again as much to two or three times as much as a year ago at this time. For several months back, many manufacturers of metal goods have been unable to get sufficient competent help. This condition is in large measure due to the fact that manufacturers of war supplies are paying such high wages and in need of so many hands that it drains the legitimate field of industry."

To come to matters more directly concerned with plating, we quote the report of the Secretary of the American Electro-Platers' Society. Note in passing that electroplating had not yet lost its hyphen thirty-four years ago.

"Secretary *Walter Fraine* reports a gross increase in membership of ten per cent for the year 1915. This percentage of increase, though less than that of the two preceding years, is gratifying in view of the changed industrial and financial conditions brought about by the European war. One new branch of the society was organized in Toledo, Ohio, and branches have been under consideration in Hartford, Conn.; Grand Rapids, Mich.; South Bend, Ind.; and Louisville, Ky. . . ."

A joint meeting of the New York and Newark Branches was covered thoroughly in the trade journals, and it is obvious that the creeping drought had not yet invaded New York:

"That sometimes useful liquid for plating purposes, H_2O was supplied in abundance, but in view of the servicable attributes of C_6H_5OH for other purposes than plating operations there were those who dallied with it in its various combinations and colors. Brown was the shade most in request. . . ."

The war in Europe had its direct impact upon the affairs of the Platers' Society, in a somewhat unexpected form. The 1916 convention had been scheduled for Toronto, but America's neutrality and Canada's belligerence introduced complications, and the Toronto Branch voluntarily relinquished the honor of being hosts to the Society.

One correspondent, a Founder of the Society, commented:

". . . Three Cheers for Toronto! Cleveland is a splendid convention city. . . ."

Turning now from the affairs of the Society to the technical and professional aspects of its members' interests, we must report an unflattering estimate of the average plater of 1916. It is not recorded that the author of the following was tarred and feathered, so we can only conclude that one virtue the plater did possess was tolerance.

" . . . Your foreman platers and proprietors of job shops, what are they? When I go into a job shop and ask for the proprietor a man comes out in rags with a burlap bag tied around his waist; bum would be the better description. The conditions are almost the same when I asked to meet the foremen of the plating department in the factories. In my country the foreman is dressed like a gentleman and wears a collar and tie. . . ."

Conditions in the plating industry were deplorable too, according to the same writer:

"How many of the large plants will allow the salesman in to see the foreman plater? As a matter of fact, very few. As for the causes of the no admittance attitude, that is our heritage of the performance of the snide salesmen of the past [who would cause difficulties between the boss and the plater by playing them off against each other]. Another cause might have been the boozer salesman inviting the plater out for a spree

that would last for some time after the salesman was gone. Or again, the graft salesman, who would bribe the plater to dump extra supplies or solutions into the sewer . . ."

The "things are going to the dogs" theme was played by other contributors, one of whom introduced a "Nordic supremacy" note into the usually neutral pages of the technical press — a note which seems today discordant, but which drew no protest from the usually articulate readers:

"In the course of my thirty years' experience I have noticed that the foreman of the plating room has been the progressive man, and for this reason he should also control, or at least supervise, the polishing and buffing, if the best results are wanted.

. . . It is regrettable, but it seems to be the fact that the polisher of today is not up to grade, and will not stand comparison with the old-time hands at the work.

"The intelligent, acute Irish, German and Swedes have been replaced by immigrants of less brain, so it has been difficult to develop good workmen from the inferior material . . ."

Nickel plating remained the predominant interest of the electroplater, and we find more articles having to do with this subject than with any other. For a few years, including the one here under review, there was a flurry of interest in the possibilities of cobalt as a substitute; but until the advent of chromium plating, nickel was the typical finish for plated ware.

Discussion of the merits of various types of nickel anodes occupied much attention and one article on the subject is worth quotation for an etymology worthy of the late lamented Colonel Stoopnagle:

"We learn from the scholars that the word anode is derived from the Greek words 'Ana' meaning 'up' and 'Ode' meaning 'away.' The word anode therefore means 'up and away.'

"As we progress in the art of electroplating we soon discover that unless anodes are endowed with that 'up and away' characteristic while hanging in the plating solution under the influence of the electric current, there is soon trouble with the solution.

"In order that an anode may 'up and away' then, it must have certain properties which render it soluble in all nickel plating solutions, or we must so change the solution that it will cause the metal to dissolve from the anode to reimburse the solution for the metal of which it has been divested at the cathode.

". . . The prospective purchaser of nickel anodes is frequently heard to remark, 'Nickel is nickel; they assay 90-92 per cent, therefore they must be good.' So, too, 'Pigs is pigs,' but the hams of a guinea pig are not much in demand by the sandwich makers . . ."

And, in the same vein, an author reminded his readers yet again that anodes are cheaper than salts:

"Tons of partially used anodes go to the scrap heap at a sacrifice of more than half their original cost per pound. Most of them, had they been given a fair chance, would have enriched the solution in which they hung, and made dollars for their owners . . .

"Flat anodes are, or should be, a thing of the past. At the present time they have no reasonable excuse for existence, unless it be to fill the orders of those who haven't learned better . . ."

The value of high-speed plating solutions was gradually being realized, and again the emphasis was upon

Second Annual Banquet of the Bridgeport Branch at the Stratfield Hotel in 1916.

nickel. One authority summed up the situation: "Slowly but surely the progressive electroplater has at last commenced to realize that the metal in his solutions is an important factor and that unless a solution contains plenty of metal he cannot carry the amperage that tells the story of the rapidity of the deposit.

"Special nickel salts that are still being sold depend not only upon a better conducting material in solution, but upon much more metal in their compound . . ."

And the possibility of bright plating is disposed of in no uncertain terms: "One of the fundamental laws governing electrodeposition is that the deposit can never be brighter than the piece to which it is applied . . ."

The status of a technology is always best judged by the writings of the practical leaders in the field; one of these in 1916, as today, was *G. B. Hogaboom*. His paper on "Some Unsolved Problems of the Electroplater" was presented before the American Electrochemical Society. He began by quoting with approval from an address by Dr. Watts: "Your friends — the electro-chemists — will no longer spend months or even years in perfecting deposition from some particular electrolytic that could never be used in competition with present solutions on account of too great cost. Platers suffer no inconsiderable loss because of misdirected effort on the part of electro-chemists, who . . . devote much of their time . . . to matters of trifling importance, or even entirely useless." Speaking now for himself, the author continued:

"The evolution of electro-plating solutions seems to have been divided into three distinct cycles — the complicated, the extremely simple, and the efficient. In the early days of the industry the construction of a solution was very complicated and little attention was given to the amount of metal deposited in a given time, or to either anode or cathode efficiency.

"About five years ago, with the advent of rapid plating salts, the pendulum swung to the other extreme, and the simple solution, one with a cyanide of the metal and an alkali cyanide, or in the case of nickel deposition, a single nickel salt solution, was considered the only way to get a fast deposit; the speed mania had taken hold of the plating fraternity.

"At the present time the pendulum is beginning to approach a more rational swing. The simple solution did not live up to its reputation, but it did one thing, and that was to set the electroplater to thinking. It was evident that the day of the complicated solution had passed; the simple solution lacked some of the good qualities of the complicated one and at the present time the electroplater is entering into the third cycle in his quest for an efficient electro-plating bath. How to obtain that is the one great unsolved problem, and in its solution the services of 'his friends — the electrochemists' are of inestimable value, but they must have unreserved assistance from the electro-plater. They are 'useless each without the other.'

"There is one way in which much assistance could be given to electro-plater aside from research work, and that is in giving him standardized electro-plating chemicals and general supplies."

There follows a list of "unsolved problems" containing twenty-four items, of which we quote a few:

"1. To what extent is the nature of the electro-deposit influenced by the physical structure of the metallic base . . . ?

"7. What simple, rapid and convenient method is there for determining the amount of nickel and free acid in the nickel bath?

"10. What causes silverware to spot out before it reaches the consumer?

"The pitting of nickel deposits is another problem to which the electro-plater has given much thought without being able to find a remedy . . .

"13. A practical solution for the deposition of chromium is greatly desired. Chromium deposits are less susceptible to the action of the air and moisture than nickel and therefore tarnish less easily.

"15. A dip to produce a brass coating on iron and steel by simple immersion, similar to a copper dip.

"20. A successful cyanide of zinc solution . . .

"21. A plating rack or a covering for one that would not be coated with metal except at the points of contact with the articles to be electro-plated. Tons upon tons of metal are deposited upon racks every year which must be refined at a heavy expense or be sold as scrap metal.

"22. A satisfactory solution for the deposition of a true bronze, i.e., copper and tin . . .

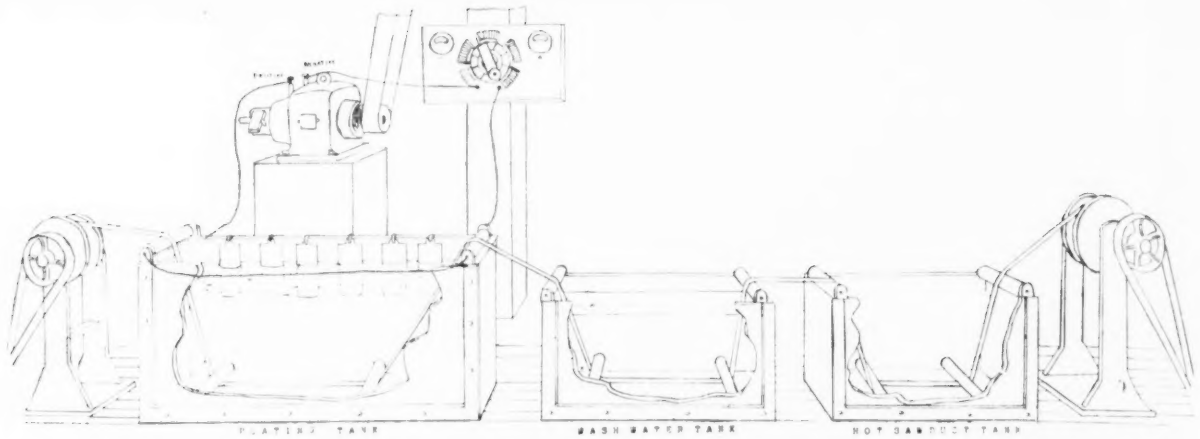
"24. What is the comparative value of cyanide of potassium and cyanide of sodium in relation to the corrosion of the anode, solubility of the compound formed at the anode, and conductivity, in the commercial electro-plating solutions generally used?"

This thought-provoking list of unsolved problems did not go without challenge for long. One author subtitled his article on "Preventive Measures Against Spotting Out" as "The Last Word on This Annoying Problem." And another called his contribution "Some Solved Problems of the Electroplater:" he was confident that "As for a covering for a plating rack . . . I can safely say that there are several compounds on the market which will answer the purpose to perfection." Apparently, however, the editor of the journal had not heard of them, as witness this exchange in the question and answer columns:

"Q—What can be done to nickel hooks in order to keep the nickel from depositing between the work.

"A—Several large firms have spent considerable time and money trying to devise a method for protecting plating racks but none of the methods that we know of are practical enough to use commercially. The principal objections to coating racks are: contamination of the cleaning solution by dissolving away some of the coating, absorption of the cleaning solutions which are carried into the plating tanks, and bare spots on the work where it has touched the insulated coating."

On the national scene there were unsolved problems too. On March 9 followers of Villa crossed into New Mexico, raided a town and killed 17 Americans; and a week later, with the Mexican government's permission, Brigadier General *John J. Pershing* at the head of 6000 troops crossed the border in pursuit of the bandit. Soon, however, the American troops became unwelcome to Mexico, and their withdrawal was requested; a request which was refused by the State Department. During June the increasing bitterness on both sides culminated in a pitched battle in which about



A GRAPHIC SKETCH OF HOW RIBBONS OF ZINC OR OTHER METAL ARE AUTOMATICALLY PLATED, CLEANED AND DRIED.

An early strip plating machine.

fifty men on each side were killed: as late as November the issue was not yet settled. And there were domestic problems: the price level was getting out of hand (it rose 40% during the year) and in spite of fairly general wage increases strikes grew both in number and violence. Some German diplomats were indicted for attempted sabotage, among them *Franz von Papen*. In this atmosphere the political parties held their conventions: the Republicans nominated *Charles E. Hughes* for president, and the Progressives *Theodore Roosevelt*. But later the Progressive party split, a large fraction returning to the Republican fold and endorsing Hughes, and Roosevelt withdrew. Wilson was easily renominated by the Democrats, and the splinter parties put forward their assortment of unknowns.

Let us return to electroplating. We find that two subjects continued to exert a fascination for contributors to the technical press: the first, standardization of chemicals and solutions. Let our correspondent speak:

"There was launched at Dayton, at the Annual Convention of the American Electro-Platers' Society an idea: the complete standardization of all chemical products used in the plating room, the solutions used in producing the results, and the exposure of any and all forms of petty graft and corruption wherever found.

". . . The plater is offered each day an ever-increasing line of what I may aptly term patent-medicine plating nostrums. He is offered cleaners galore that are essentially the same product, but are sold under fancy names at about three times the normal value if they were sold under their common commercial names of cauterized (*sic*) soda ash, sodium hydrates and aluminum silicate. He is confronted with a never-ending line of plating salts, all having fancy names and sold at an excessive price when compared with the actual price and value of the prime factors, the metal and its reducing agent; he is offered substitutes for cyanide which, based upon their cyanogen content, cost at least two dollars a pound as compared with the twenty cent price or less of cyanides under the proper name.

"Mystery. Nostrums. Patent-medicines. All belong in the same class. They should not be tolerated by anyone who pays the bills, directly or indirectly.

"(The) plan in its entirety contemplates the ultimate standardization of plating solutions. Why not? The old fogy who insists upon secrecy and mystery and his own particular brand of 'dope' for his solutions will be the only one injured. He is reactionary in a sense anyway, and deserves his fate.

"The Government maintains at Washington a Bureau of Standards, which is ready and willing at all times to cooperate with interested parties in any work looking toward the standardization of any product or industry . . . There is still some 'mystery' in the plating business, and until it is removed the business will not be as healthy as it deserves to be. Get together and let's remove the 'myst' (mist) from this particular brand of mystery." The pun (pun) is the author's, not mine.

The other subject which came up every so often was that of cleaning and plating in the same solution. Here is one explanation of the proposed process:

"The realization that it is possible to cleanse metals electrically and deposit a heavy coat of copper, bronze or brass in the same solution in less than one-third of the time required in the ordinary solutions of cyanides and even acid solutions is of particular interest at the present time.

"Cost is always an important factor, so on every hand the manufacturer is adopting the same methods of more than a quarter of a century ago, when the French syndicate controlled the copper market of the world, forcing the manufacturer of metal goods to adopt the least cost of production and the use of iron and steel in the place of copper, bronze or brass wherever possible. It was the abnormal condition created by the French syndicate in an effort to control the copper output of the world that became one of the greatest factors in the development of the electroplating industry and forced the manufacturer to adopt the use of iron and steel in the manufacture of his products and electro-plate them to represent the respective metals . . .

"It has always been realized that the production of a chemically clean surface was an important factor in the development of a successful electrodeposit . . . In the formula which I will give for cleaning and plating in the same solution, I have considered the addition of sodium silicate and aluminum silicate as important factors in connection with the cleaning and plating operations when used in connection with the sodium

carbonate and sodium hydroxide as separate factors. . .

"Water ..... 1 gallon
Commercial sodium hydroxide ..... 6 ounces
Commercial soda ash ..... 6 ounces
Commercial sodium silicate (water glass) 1 ounce
Aluminum silicate ..... ¼ ounce
Sodium cyanide 129% ..... 1 ounce
Copper cyanide (70% metal, 30% cyanogen) ..... 1 ounce

"The temperature should be 180 degrees and the voltage for iron and steel 6 volts; for die castings and other metals, 4 to 5 volts . . .

"Manufacturing concerns east and west are utilizing this solution with permission and have expressed the highest appreciation for the results obtained . . ."

Other contributors, however, disagreed and wrote that the idea of a combined cleaner-plating bath had little or no merit.

If you think continuous strip plating is pretty new, you will be interested in a method for plating strip zinc, the illustration of which is here reproduced. See Figure I.

Here is an early mention — unflattering — of rectifiers:

Q—Will you kindly advise us if plating by a rectifier, electrically or chemically, has ever been accomplished by any one, and if so whether it is a success or not. Also is there any economy in its use and is it as reliable as a dynamo?

"A—Transformers are used to change the voltage of a 110 volt or more circuit to a lower voltage and give a corresponding amperage suitable for plating purposes. Chemical rectifiers have also been used for the same purpose.

"There is no economy in such methods, but a greater expense in the electrical energy to gain the desired change. The method is no doubt reliable, but the dynamo of low voltage and corresponding amperage, high or low, will continue to be used until some method of development by storage batteries can be utilized without the use of mechanical energy in any form to maintain a constant flow of electrical energy without deterioration.

"Until such time water power developed into mechanical energy and then to electrical energy by the use of the dynamo will prove to be the cheapest source of energy. Following the water power, steam is the next best equivalent."

And a few for the "quote without comment" department:

"Q—I shall be pleased to receive some information about obtaining bright surfaces on articles in tin, zinc and nickel solutions or baths.

"A—We should have to write a book in order to supply the information desired."

"Q—Our nickel plater poured a bottle of nitric acid into his nickel solution mistaking it for sulphuric acid. We are at a loss what to do. If the solution is spoiled, please let us know just as soon as possible.

"A—We are sorry to advise that there is no remedy for the solution. You will have to make up a new one."

"Q—How can we get a good deposit of nickel about ½ inch thick?

"A—To obtain a good deposit of nickel ½ inch thick

The first job plating shop in Cleveland, located at what is now 1591 Columbus Road. The Valley Plating Works was established in 1883.

is such a difficult proposition that it will require the undivided attention of an expert nickel plater. We give it as our opinion that the most practical way would be to obtain a copper shell, then plate both sides in a warm nickel solution."

"Q—Is there a way to get the black deposit out of the silver solution? I put in too much carbon; doesn't hurt the work but it doesn't look right.

"A—If a very high voltage is available, all the silver anodes should be put in as usual, then a small strip of clean copper should be hung on the plating rod and the full current turned on for a few minutes. If it is not possible to obtain a high voltage the only way to overcome the trouble will be to increase the intensity of the solution by adding cyanide and cyanide of silver."

And now if you will fill up those empty seats in front of the hall, I should like to have you hear about the function of boric acid in a nickel solution, as expounded thirty-four years ago in the pages of a technical journal (not this one).

"We often see published formulas for nickel solutions which give, among other compounds, that of boric acid, the quantity stated varying with the different authors' experience. But although these authors emphasize the necessity of boric acid, the writer has never read any explanation of the functions of boric acid in the solution.

". . . When we get down to figuring the amount of oxygen which a given number of amperes of the electric current will displace to combine with the other elements (hydrogen, for instance) and add a compound which will take up the oxygen at the anode and then give it up to the hydrogen at the cathode, to again form water, then we should figure out the quantity of boric acid to use, balancing it with the other elements affected.

"If we have a double salt solution and wish to increase its efficiency we can do so by adding common salt, figuring its content of chlorine to correspond to the quantity of sulphuric acid in combination with the nickel. Then figure the number of amperes that may be used to completely saturate the known quantity of

sodium with oxygen which is released by the current forcing it out of combination with other elements, and combining the chlorine with the nickel to form chloride of nickel. We could then figure the quantity of boric acid necessary to take the electric element completely into combination with it at the anode. Thus we will see that the different elements must be added in the proportions in which they interchange and combine.

"To make the meaning clearer[1] we will take a solution composed of nickel sulphate, sodium chloride and boric acid. As the electric element forces oxygen out at the anode it necessarily forms a new combination with the hydrogen and perhaps the nickel. But as we have boric acid there as a catalytic agent, it takes charge of the electric current and forms a combination with the nickel. The chlorine which has been forced out of the sodium rushes in to take the place of the boric acid and forms chloride of nickel, having electrohydrogen (we will call it that) as its solvent.

"If we raise the quantity of electricity above that of the chlorine, or the chlorine above that of the boric acid, and all three above the quantity of sulphate of nickel, we would not raise the efficiency of the solution to correspond to the quantity of current being used, and as a result we would have a blackened deposit.

. . . This is what takes place when the element electricity starts on its way back to the generator. The oxygen is forced out of the solution at the anode, its volume being exactly equal to the volume of electricity which has entered the solution. Then the boric acid takes charge of the electricity for an instant and forms a combination with the nickel sulphate. This in turn forms a combination which has a stronger affinity for the chlorine than it has for the sulphuric acid, and chloride of nickel is formed, the sodium combining with the oxygen and the anode and the sulphuric acid combining with the new oxide of nickel to form more sulphate.

"Then at the cathode the electricity leaves the hydrogen, which combines with the chlorine for an instant when it is forced out by the sodium oxide, the sodium taking the chlorine and the oxygen and hydrogen.[2] We will see that the cycles are complete in this — that no elements are lost[3] . . .

"It will be seen by this that the handling of these solutions must be done by a man who understands their actions. The idea that some employers have that a foreman plater is able to produce the best work and maintain a high efficiency in production from the tanks, and high labor efficiency throughout the department, with men in the plating room who know nothing beyond cleaning an article and suspending it in the solution, is one which they should relegate to the discard."[4]

1. And about time, too!
2. Sounds like a square dance to me, too.
3. Fortunately.
4. What do you know—a moral!

The above author's unusual theories of electricity were capable of elucidating that old bugaboo, the spotting out problem, also. Listen:

"There is still fresh in memory my first experiences in the art of electroplating. I had fitted up a laboratory at home and had read all the books I could get on the subject and I thought I was some plater! The conceit was taken out of me when I landed my first job as a plater and when I was called into the office on the "little green carpet" and told that I was doing the rottenest work that had ever been done in that shop. My pride was hurt, of course. But I decided that I would do the best that had ever been done, and I did.

"In those days the platers were a jealous lot, guarding their formulas and methods with such secrecy, and knocking the other fellow with impunity. I found it hard to get information. I could get no help except from the traveling salesmen, and their visits were few and their time was limited, so they were not much help after all. I had hard brass, soft brass, red brass, yellow brass, and sometimes gray and blue and green. I had all the troubles that beset him who works without knowing what he does. I had spotting out, blisters stars, streaks, and granular deposits. I supposed that the electricity acted as a magnet and drew the metal from the anode to the work. I did not know the meaning of cathode. I did not know, then, that the deposition of metals or other substances depended upon the breaking up of molecules and their separation into their different elements. I did not know if the electricity acted as an element or was converted into an element by coming into contact with other elements, and that the deposition of the metal was due to a strictly chemical action instead of what was believed to be an action based upon the power of a certain force. I did not know that the disintegration of the anode was brought about by the elements set free recombining to form solvents for the metal and replenishing of solution: all was mystery.

"I could not understand the mystery of disintegration and recombination. I could not comprehend that my spotting out troubles were due to any other cause than that cyanide had entered the pores of the metal: I could not see how peeling or stripping could be caused by anything else than uncleanliness or too much current. . . .

"Now let us get down to business. Suppose, Mr. Manufacturer, that you are putting out a plated article which must be highly finished and must stay that way. We will say that you are brass plating and that your goods have a very pleasing appearance. You wish to hold them that way and you lacquer them. Presto! The thing is done. Well, let's see. In time you get a letter from your best customer which reads something like this: "Last shipment of goods from you are badly tarnished or rusted. Can not dispose of them. Am returning at your expense. Please ship better goods or we will be compelled to buy elsewhere." Did that ever happen? Of course!

Then you lay it to rough handling or to the lacquer, and you cause some uneasiness among your employes by "going after them." You never dream that the trouble is caused by an improperly balanced solution. The work was all right when it was lacquered and, of course, it was not in the plating.

"We will now look into that. Your busy season was on and you cried out "rush." You demanded more work through the plating department, and your plater, who had proven himself a good man, rises to the occasion. He raises the density of his solution so that he may be able to plate faster and meet the demands made upon him. He does not know that he is only

saturating the elements that take charge of the electric element and preciptate the metal out as a secondary reaction, which is desirable in cyanide solutions, instead of a direct action of the electricity, because he has never been taught that. No one has ever written anything along that line and he has never been awakened to the fact that increasing the metallic content of a cyanide solution without increasing the content of free cyanide proportionately, ounce for ounce, leads to the combination of electricity with either the potassium or sodium in solution or with the metal itself, and brings about the defective results of which your customer has written you.

"Now, we have a solution composed of copper cyanide. We have proportioned the different salts so that we will have just enough free hydrogen to take charge of a given number of amperes, figuring the volume of oxygen set free to exactly equal the number of amperes entering the solution. We will thus deposit copper as a secondary reaction because the equilibrium of the solution is destroyed by the electricity forcing out one of the elements of the solvent for the metal at the anode, and taking its place, leaving it at the cathode to go back to the generator. This leaves the hydrogen free and there is nothing with which it can combine on the instant, and copper is precipitated merely because its equivalent of solvent is gone and there is nothing to hold it in solution, the metal filling the chemical vacuum created by the dissolution of the electro-hydrogen compound; the metal forcing the hydrogen away at the instant it is set free, which leaves a chemically clean, dry surface to receive the metal.

"Any metal deposited this way will never cause any trouble after it has been placed in stock. It will not spot out.

"Now let us raise the metal content to satusation of the water and sodium cyanide. When we do this we have no free element with which electricity can combine and it enters into combination, not by force, but by chemical affinity, with the next compound which will take it. This is sodium cyanide. Then we would have the sodium cyanide molecules broken up at the cathode, and as the cyanide being already saturated with another element — copper — electricity combines with both and breaks up the entire molecule, depositing the sodium along with the copper. As sodium and copper do not alloy permanently in a metallic state, the sodium or potassium, as the case may be, readily combines with the hydrogen to form a hydride, which upon exposure to the atmosphere absorbs oxygen and forms the hydroxide which oxidizes the metal and causes the spots. This, gentlemen, is the cause of spotting out."

Well, there you are; don't ask me again. We had better look at the news.

On the night of November 7, *Charles E. Hughes* went to bed believing he had been elected President, but when the returns from California came in, the final count was Wilson 9,129,000 — Hughes 8,536,000; and in the Electoral College 380 to 254. The Socialist candidate received 590,000 votes and there were scattered ballots for a Prohibitionist and a Socialist-Labor candidate. The Democratic majority in congress was somewhat reduced.

During a preparedness day parade in San Francisco a bomb exploded bringing death to six and injuries to twenty-five persons. The ensuing investigation and trial echoed down the years almost to the present day: for the accused were *Warren K. Billings* and *Tom Mooney*. Although they were both convicted and sentenced, the one to life imprisonment and the other to death, many thought them victims of a frame-up and the cry of "Free Tom Mooney!" became a familiar slogan of radical groups during the depression years.

Another explosion only eight days later resulted in a similarly doubtful verdict: the munitions plant at Black Tom Island, New Jersey, blew up at a cost of $20,000,000; and although everyone was sure the disaster was the work of German saboteurs, a mixed claims commission in 1930 was forced to disallow damage claims for lack of evidence.

New records were being set in aviation. *Carlstrom* flew the 900 miles from Chicago to New York in 8 hr. 28½ min. and set a new American non-stop record from Chicago to Erie, Pa. (452 miles) in 4 hr. 17½ min. This record soon fell when *Ruth Law* flew from Chicago to Hornell, N. Y. (500 miles) non-stop in 8 hr. 55½ min.

The stalemate of war continued in Europe. We purchased the Virgin Islands from Denmark for 25 million dollars. Two beloved literary figures died during the year: *James Whitcomb Riley* at 63 and *Jack London* at 40. President Wilson made another attempt to end the carnage in Europe by sending a note to all belligerents suggesting they communicate their peace terms — an effort which some historians believe came within an ace of succeeding. And that's the news to this moment.

Restoration of Ancient Bronzes and Other Alloys

ANCIENT relics and objects of art found in tombs or buried in the ground usually have to be restored before they have any practical value as a museum piece. These objects include items such as jewelry, statues, cups, plates, coins, and ornaments, and vary in chemical composition from bronze to silver or gold with various alloying impurities such as tin or lead. They are found in varying forms of preservation depending upon their composition and location or conditions of the location in which they were found.

Invariably objects of gold resist the corrosive action of the soil and atmosphere better than other alloys and they seldom require more than a cleaning operation. On the other hand objects of silver or bronze are susceptable to the corrosive action of the soil or atmosphere in which they were found and their condition depends upon the extent of these factors. Water present merely as moisture in the soil in which a bronze lies buried may be sufficient to mineralize the entire surface of the bronze. Continued exposure to these conditions will in time completely corrode the metal so that only a shell of corrosion products remains, the metal having completely disappeared.

An analysis of corrosion products of restored objects has indicated the presence of layers of various copper compounds such as the carbonate (green malachite or blue azurite), the chloride and oxide or oxychloride, and occasionally the sulphate or sulphide. Silver, or bronzes containing silver, often contain silver oxide or silver in the crust; but in the presence of the less noble metals such as copper, tin, lead and zinc, silver is usually present in the crust as the metal.

Early attempts at restoration with hammer and chisel or wire brush rendered the object worthless, particularly if it was originally covered with a moderately heavy crust. It reveals a shapeless piece of metal at best and completely removes any traces of engraving or carving. Later attempts with dilute acids used to dissolve the crust are not much more effective. *Finkener* was one of the first to use an electrolytic method. He used a 2% solution of potassium cyanide. Later in 1911 *Francois Margival* also discussed electrolytic methods of restoration. In 1921 *Dr. Alexander Scott* under the direction of the British Museum published an interesting booklet on the chemical methods of removing crust formations. With the realization that corrosion is an electrochemical process the Metropolitan Museum of Art secured the services of *Dr. Colin Fink* and *Charles H. Eldridge* to assist in developing a more effective method of restoring their ancient art objects. Their broad experience in electrochemistry and metallurgy made them well fitted to undertake this research. The following methods and procedures were developed by them.

After considerable investigation an electrolyte of 2% sodium hydroxide was standardized upon. The individual procedure in each case depends upon the object: its size, shape, fragility, and composition. The object is usually wrapped with fine annealed copper wire, one to two turns per inch, and electrical connections made with several turns of this wire. The object is then hung in the tank. When there is danger that it might not hold together during the electrolytic process it is packed in clean white sand and the caustic solution poured over it. Either iron, Duriron or platinum anodes may be used with equal success. The object is then made the cathode at approximately 0.05 amperes per square inch and a potential of 110 volts. Sometimes the resistance of the crust at the point of contact will be so high that little or no current will flow, but rather than file a clean contact it is better to start the cell at night, allowing the solution to slowly penetrate the crust and usually by morning the required amperage will be flowing. Objects covered with a clayey crust are best electrolyzed for 24 hours then the solution changed and again electrolyzed for 24 hours, repeating the process until the electrolytic cycle is completed. The time required for complete reduction of the object depends largely upon the thickness of the crust. A thin crust of $\frac{1}{16}$" to $\frac{1}{8}$" thick usually requires three to four days. Complete reduction of the crust is indicated by a free evolution of gas at the cathode. The object is then carefully removed from the solution and thoroughly rinsed by soaking in several clean warm water rinses until the sodium hydroxide has been completely removed.

We have now arrived at a stage where the subsequent treatment must fit the physical strength of the specimen. If the object treated originally had a hard metal surface under a thin sandy layer of crust we may remove the reduced copper film or layer with a stiff bristle brush or soft wire brush. If on the other hand we find that no true metallic core is present we dare not subject the surface to any pressure or friction but must remove the reduced copper by successive dips in 20% nitric acid. The object is rinsed between each successive dip and the process completed when the hard metal or oxide is completely exposed. It is then thoroughly rinsed and lacquered to afford further protection.

The electrolytic method described above has also been effectively used to arrest the progressive attack of the bronze disease, a phenomenon similar to the well known "tin pest" where tin is gradually changed from one allotropic form to another. The immediate cause of the bronze disease is the presence of a trace of chloride. The corrosive action is progressive and continues until the entire object or area is covered with the green malachite or azurite.

Production Plating at Hall-Mack

By Fred M. Burt, *Los Angeles, Calif.*

SINCE starting in business in 1922, the trademark of *Hall-Mack Company*, Los Angeles, has come to stand for quality in the field of bathroom accessories. This fact is recognized by architects, owners, and builders from coast to coast, and has brought about a constantly increasing volume of sales. Today Hall-Mack is one of the country's largest producers of a very complete line of bathroom accessories and medicine cabinets.

Hall-Mack products are sold by dealers in the plumbing, tile, and hardware trades throughout the United States, with quick shipments made to customers in the East and Middle West from a complete factory branch with full warehouse stock in Chicago. The West and Southwest are served from the Los Angeles factory.

In the company's three California plants, all items and parts are fabricated and processed in large quantity runs. Besides the main plant in the center of Los Angeles, a subsidiary plant, *Peat Mfg. Co.*, in nearby Downey, is devoted to the production of die-castings and plastic parts. The third plant, also in Los Angeles, assembles medicine cabinets.

In the main plant, about one-third of the area is occupied by polishing and plating departments and supplementary and servicing operations. Located so as to promote the progressive flow of these units and their component parts, other large areas are used for inspection, assembly work, packing, storerooms and shipping.

The well-arranged, modernly equipped, hand and machine polishing, semi-automatic and automatic plating operations are set up and carried on for low unit cost and volume production.

Racking and Degreasing

Parts for finishing are delivered to one of three starting points. If the parts do not require polishing, they are first degreased, then racked and carried by the conveyor to the automatic cleaning lines. Parts which are to be hand polished are transferred to the hand polishing department, and following this they are racked, degreased, and conveyed to the cleaner line. Parts which can be polished on the 12-head straight line automatic are conveyed from there to the racking area, then they are degreased and carried on the conveyor to the automatic cleaning line.

Parts are delivered to the racking area in specially designed wood and metal tote boxes or pans. The racks, in about 40 different designs, are returned from the distant un-racking tables on the return travel of the conveyor. The overall length of the conveyor is 875 feet.

The degreasing machines, which are adjacent to the racking area, are equipped with ½ ton overhead hoists to facilitate the handling of heavy loads of work.

Polishing and Buffing

Located so its delivery end is adjacent to the degreasers is a 12-head straight line automatic polishing machine for polishing and buffing certain parts having flat surfaces and simple curves. This machine uses liquid abrasives. Another small 2-head machine

Figure 1. Display of typical Hall-Mack chrome-plated and plastic bathroom accessories and porcelain-enameled medicine cabinets.

is also located here for touch up operations when necessary.

The main polishing room is equipped with 40 double-spindle polishing lathes, all equipped with adjustable speed control. Eighty operators are employed here in hand polishing a wide variety of shapes and sizes of die-cast and brass parts. There are also two 4-spindle semi-automatics and five automatic tubing polishers in this department. When the shape and volume of a given part permit, automatic polishing is used, but as so many of the items handled do not fall in this category, a great amount of hand polishing is necessary. In fact, a good quantity of Hall-Mack's polishing is jobbed out to shops having the necessary equipment and skill.

Cleaning

As mentioned above, all parts after polishing and buffing are degreased, racked, and conveyed to the start of the automatic cleaning lines. There are two full-automatic cleaning machines. The first line, used for zinc die-castings, has nine tanks, as follows:

1—Alkaline electrocleaner — Direct current @ 160°F.
2—Alkaline electrocleaner — Reverse current @ 160°F.
3—Rinse in a constant flow of cold water

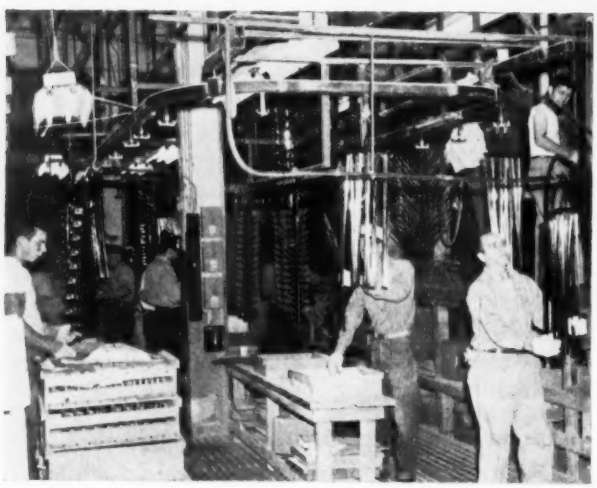


Figure 2. Racking up polished parts to be plated. The variable speed (operating at about 15-fpm) conveyor is returning empty racks at left, carrying loaded racks away at right, alongside platform for two vapor-degreasing tanks.

4—Acid Dip—5% H_2SO_4
5—Rinse
6—Rochelle Copper Strike
7—Rochelle Copper Strike
8—Cold Rine
9—Cold Rinse

The automatic cleaning machine for brass parts incorporates the following steps:

1—Hot water 180-190°F.
2—Electrocleaner—Reverse and direct current
3—Cold Rinse

Figure 3. Twelve head automatic polishing machine, with six heads in each row. Note spraying guns.

Figure 4. Section of the hand-polishing area, showing some of 40 twin-head polishing lathes.

4—Cold Rinse
5—Acid Dip—5% H_2SO_4
6—Cold Rinse
7—Rochelle copper strike
8—Cold Rinse
9—Acid dip—weak HCl
10—Cold Rinse

All tanks requiring heat are heated by immersed steam coils, the steam being generated from three gas-fired boilers.

At the unloading end of the cleaning machine the racked die-cast parts are loaded on a semi-automatic

plating carrier in a 2800 gallon tank of pyrophosphate copper solution for a 12 min. plating travel. The racks of parts are then put through successive dips in plain water, HCl (mild solution), H_2SO_4 (mild solution) and then transferred for bright nickel plating to the adjacent semi-automatic. This machine is 34 ft. long (for about 60' travel in 24 min. plating time) and contains 6,000 gallons of nickel solution. When the nickel-plated die-cast parts are removed from the tank they are but a few feet from where they are to be loaded for chrome-plating. This nickel-plating unit has a 500 ampere rectifier with automatic voltage control.

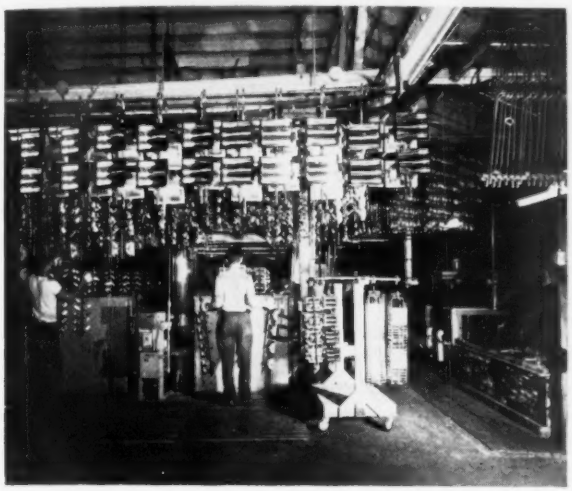


Figure 5. Conveyor brings racked parts to this point for unloading and placement on twin lines of full automatic cleaning machine. Zinc parts on line at left, brass at right.

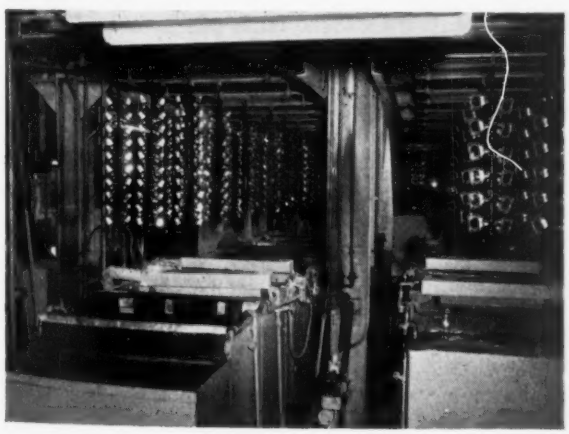


Figure 6. Unloading end of cleaning machine, with handling mechanism in "up" position while moving racked parts forward for immersion in next tanks.

and uses continuous solution filtering. Similar filtering arrangements are used for the copper solution and the second nickel-plating tank. The latter is another semi-automatic machine, installed January 1950, with a tank 28' long, 5' wide, 5' deep, holding 4700 gallons. As the brass parts come off the cleaner line, they are dipped in a drag-out rinse and then placed on the nickel tank carrier for an 8 min. plating travel to the other end of the tank and back, where they are then loaded on the adjacent chrome-plating machine. Nearby is an intercommunication station, with another station at the racking tables, which is used at times to advise as to what items should be racked and delivered by the

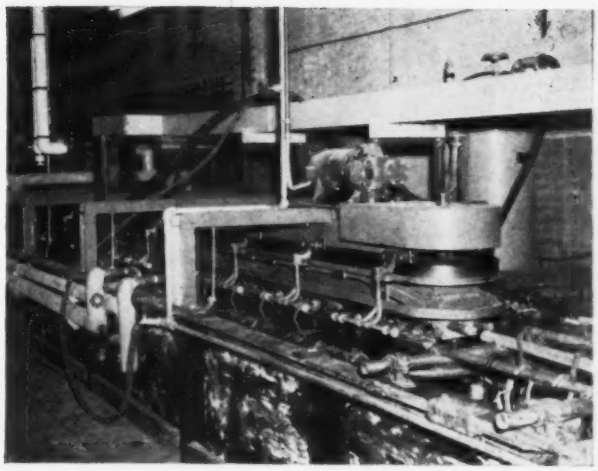


Figure 7. Semi-automatic nickel-plating unit for brass; loading and unloading at end at left; at other end (right) is a wire overflow into decontamination tank where low voltage current plates out impurities of iron, copper, zinc, and lead.

conveyor for plating. At one end of this section there are two spare tanks, with piping connections to the two nickel and one copper plating tanks to allow pumping out of solutions while tanks are cleaned. One tank holds 6,000 gal., for nickel; the other 3,000 gal., for copper.

The full-automatic machine for decorative chrome-plating has identical lines of 13 tanks each, for both the die-cast and brass parts.

The mechanical handling mechanism of the machine lowers racks of parts in each line into all of the 320 gal. tanks simultaneously for a 1½ min. immersion, then raises and moves the racks forward to the next tank, for another immersion. Racks are being continuously loaded at one end and taken off at the other. There is one exception; this is at the 1300 gal. chrome-plating tanks, where the cross-bars carrying the racks are lowered into the tanks so that the ends of the bars rest on conveyor chains on each side of the tank, and are then carried to the end of the tank for 1½ min. plating time, where they are again picked up for the former method of handling.

Figure 8. Plating Superintendent Don M. Bedwell, one of Los Angeles' plating pioneers. Charter member and a past president of the Los Angeles Branch; also General Chairman for the 1951 A.E.S. Convention.

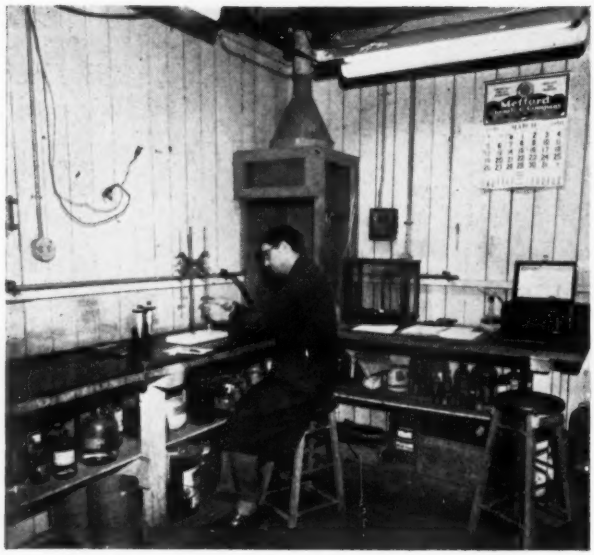


Figure 9. View of plating control laboratory, where regular solution and deposit tests are made.

The successive tank solutions in both lines are as follows:

1—Water rinse (lead-lined steel tank) (These first two tanks unnecessary in this operation, but were made available for other special work)
2—Water rinse (lead-lined steel tank)
3—Mild (½%) H_2SO_4 solution (rubber-lined steel tank)
4—Water spray rinse
5—Chrome-plating tank
6—Reclaim rinse (lead-lined tank)
7—Water rinse (lead-lined)
8—Water rinse
9—Water rinse
10—Hot water rinse, 160°F.
11—Drip tank
12 and 13—Drying tanks with steam pipes at bottom.

From the area where the loaded racks are removed from the chrome line, the conveyor runs over the unracking tables. Empty racks are then replaced on the conveyor for stripping, and returned to the racking area for re-use.

The rack stripping treatment dips the racks successively in:

1—Hot caustic stripping solution, with reverse current
2—Cold water rinse
3—H_2SO_4 (5-10%) solution dip
4—Cold water rinse
5—Hot water rinse

At the head of this line there is a separate 500-gal. tank for a preliminary stripping of more heavily coated racks; this is done in four minutes time in an H_2SO_4 solution, with reverse current.

The chrome-plated parts are moved from the unracking tables for inspections, etc. Some of the higher quality items are given a color-buffing on hand lathes using loose color buffs.

In an adjacent room is the special plating shop. In addition to cleaning and copper strike tanks, there is also a reverse current H_2SO_4 (sulphuric acid) strip tank. Opposite the line are a 400 gal. chrome-plating tank, and an 870 gal. nickel plating tank, both manually operated; also a 110 gal. experimental chrome-plating tank. Re-worked rejects, and items whose design and shape are not suitable for machine plating are plated in this department.

Rack and other maintenance work is done in the maintenance shop. The wide variety of special racks are made up here. Some are sent out for coating while others are coated in the shop, using a plastic-base coating with a small amount of cold water make-up. After dipping, the coating is cured on the racks, in hot water (about 5 minutes at 180°F.).

Uses Wanted for Unusual New Metal

Wanted: Commercial uses for a costly, little-known metal which will melt when held in the hand, and has other unusual properties of so far undetermined utility.

The metal is gallium, a by-product of the extraction of lead and zinc. At present a price of $1,300 a pound is quoted on the silvery, unusual material. Small quantities have been sent to laboratories over the country doing various types of research. So far the most important work on potential uses is being done by the Navy in experiments at Bethesda, Maryland. A radioactive isotopic form of one of the gallium salts has been injected into test animals and autoradiographs made of the animals' bones. These tests show that the material has the ability of going directly to the growth areas within the bones and concentrating there. Since gallium, in this form, has a relatively short radioactive life, there are indications that it may prove valuable in diagnosis and possible treatment of cancer of the bone. Work done so far is still in the preliminary stages.

The producers of metallic gallium believe in the eventual demand for this metal for some yet-undiscovered purpose, sooner or later.

Ordinarily one thinks of rare metals as being stored in vaults or similar safe storage spots. With gallium, the situation is quite different. Stocks have to be kept in a refrigerator because of its extremely low melting point of 85°F. As it is prepared for sale to laboratories it is in the form of metallic crystals of a distinctive thickened leaf shape. At ordinary summer temperature these will melt into a silvery liquid if not refrigerated. As the temperature drops below 85 the metal again solidifies; thus the cold storage method is necessary to keep the material in a constant form.

Since interior body temperature is 98.6 degrees gallium is readily melted by body heat. When a piece of it is held in the clenched hand there is a distinctly cold sensation as the material is warmed and begins to liquefy. Soon one edge gives way, just as a silver coin would under more intense heat, and the metal flows out between the fingers.

For a time it was thought that another property of gallium, its high boiling point of 3,500°, might lead to its use as a heat transfer agent in atomic power piles. However, this possibility later was discounted because of the relatively small amount of the metal in existence, and the large quantities of material that would be required for extensive atomic power development.

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Electropolishing of Gold

Question: Can you give us any formulas for solutions that can be used to electropolish gold and gold alloys?

W. G. R.

Answer: The following bath has been used to electropolish gold:

Potassium cyanide	67.5 gm/l.
Rochelle salt	15 "
Pot. Ferrocyanide	15 "
Phosphoric acid	22.5 "
Ammonium Hydroxide	2.5 ml/l
Temp.	60°C
Voltage	9-10
Current Density	1400 a. s. f.
Circulation	Constant circulation of the solution.

Another electropolishing bath was developed and patented by Battelle Development Corp., Columbus 1, O. from whom you can obtain further details.

Electropolishing Silver

Question: Can you give me some information on a method for electropolishing silver in cyanide baths which is not covered by patents. I would also like to know how bright silver deposits can be obtained.

N. J. F.

Answer: The only methods of which we are aware for electropolishing silver in cyanide baths are covered by patents issued to Arthur D. Little, Inc., of Cambridge, Mass. You can obtain complete details by writing to them.

It is not possible to obtain fully bright, lustrous deposits of silver directly from the bath, except for very thin flash coatings over a bright nickel base. Heavier deposits have a smoky or cloudy appearance, and usually are colored or electropolished for full lustre. A number of brighteners for silver plating have been patented and tried out in commercial practice, but carbon disulfide and ammonium thiosulfate still seem to be preferred by most silver platers.

Electroformed Spray Painting Masks

Question: We would like to know how electroformed masks are made for use in spray painting certain areas only of shaped objects. We have a painting problem in which such masks would be of great benefit.

P. N.

Answer: Briefly, the method is as follows: Those areas on the part which are to be painted are first stopped off with a good insulating material (tape, lacquer, etc.). The remainder of the surface of the part is made conductive, if it is not already conductive, by any one of a number of metallizing methods. After this the object is placed in the plating bath, usually nickel or copper, and the conductive areas plated with a very heavy deposit of metal. The thickness of deposit required depends on the amount of rigidity required in the finished mask. After plating, the deposit is stripped from the object by cutting through the deposit and splitting the deposit from the object. Those areas that were stopped off originally will now be holes in the deposit, through which the paint can be sprayed. While this all sounds very simple, there are a number of tricks in making successful spray painting masks. It is especially important to get sharp edges around the open areas, so that the sprayed paint will not be able to creep under the mask. Reinforcing the mask to withstand rough production usage and not interfere with the spraying is also required.

Electroformed masks may be obtained from several companies specializing in this work. Their addresses are being sent to you.

Stripping Cobalt-Nickel Deposits

Question: We have been using the standard formulas for stripping nickel from steel, but these seem to work very slowly on cobalt-nickel type deposits. Can you give us a better formula that will strip these deposits more rapidly?

N. J.

Answer: While it is true that there may be some slight difference on the rate of attack for cobalt-nickel deposits and organic type bright nickel plating, the difference is normally so small that it would only be noticed on stripping extremely heavy deposits. The regular stripping bath of sulfuric acid plus glycerine or copper sulfate, reverse current, is widely used commercially. It is more than likely that something else is at fault; check the cathode area and the conditions of the cathodes to see that sufficient current is flowing. Heavy films on the cathodes will slow down the stripping. The composition of the bath should also be checked, as it may require acid additions. You may be interested in a new chemical (no current) stripping bath recently announced, which is claimed to strip up to .001" of nickel per hour. The name of the firm that can supply this material is being sent to you.

Dark Recesses in Barrel Nickel Plating

Question: We are plating barrel nickel on small steel stampings. Recently we have been troubled with dark spots on the recessed areas. We use a cadmium brightener with each load. Can you suggest what may be

causing our trouble, and what we can do to get a good bright coverage in these recesses?

L. S. H.

Answer: There are several possibilities for this trouble. The solution may contain an excessive amount of metallic impurities such as copper, zinc, or lead. Electrolytic purification will remove such impurities. It is also possible that your cleaning cycle is not getting all the dirt out of the recessed places, or that these areas are not sufficiently smooth before plating to enable you to get a bright deposit. You may be overloading the barrels, in which case the parts may not be getting the proper amount of current nor good current distribution. We suggest that you contact the supplier of the brightener for his recommendations before trying to doctor the bath yourself. There are so many factors involved in barrel plating, especially bright barrel plating, that an on-the-spot analysis is invariably required to isolate the causes of defective operation.

Brittle Nickel from Lead-Lined Tank

Question: I occasionally run into cracking nickel plate when using the following bath in a lead lined tank:

Nickel sulfate	9.0 oz./gal.
Ammonium Chloride	.85 "
pH	6.8
Temp.	105 F.
C. D.	10 a. s. f.

Do you think the lining on the tank could be causing this brittleness and cracking?

Answer: The above formula is fairly standard in the production of electro-types and has given excellent results. It is possible in an old solution that sufficient of the lead lining has been dissolved to contaminate the bath and cause the trouble you mention. This lead can be removed by electrolytic purification (dummying) at low current density. It is also possible that your bath is contaminated with organic matter, in which case a carbon filtration is suggested. Both these operations are covered in detail in the Guidebook-Directory. While the lead lining may be satisfactory for this low chloride concentration, a rubber-lined tank would be better.

Maintaining Yellow Color in Brass Plating

Question: We have been experiencing copper color (red) on our brass plating, and would appreciate any information you could send us on how to keep a good yellow brass color.

F. D. M.

Answer: Control of color in brass plating requires unusually close control of all factors, especially the copper-zinc metal ratio in the solution, temperature, current density, and free cyanide contents. Decreasing the temperature and the current density will cause more zinc to be deposited in the alloy, hence the deposit will be more yellow. Increasing the free cyanide also tends to give yellower deposits. The pH of the bath is also important, and should be kept above 12 for yellow deposits with caustic soda. The most important thing in color control is to vary the conditions until the desired color of deposit is obtained, then maintain these conditions with a rigid system of control over all the factors involved.

Plating Long Bumpers in Two Operations

Question: We have a problem in plating long bumpers that will not fit into our chrome tanks so that they can be plated all over at one time. We have been doing one end first, then the other end, but have difficulty in avoiding the junction line or in buffing it out after plating. Can you suggest some way to eliminate this problem?

D. E.

Answer: We do not know of any way to avoid the junction line when using this method of plating. However, you can lessen the work involved in blending the junction line by following these steps: After plating one end, wrap masking tape around the bumper, several inches from the edge of the plating, up on the plated end. The other end is then plated, first stripping the exposed chrome deposit below the stopoff tape in Hydrochloric acid down to the nickel. After the second chrome plating step the tape can be removed and the junction line blended in by color buffing. If possible, the junction line should be located where it will be least conspicuous, possibly at a point which will be covered over by bumper guards.

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ORegon 3-6256
Chicago Laboratory
509 S. Wabash Ave. Chicago 5
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PATENTS

Packing Composition for Removal of Zinc From Zinc-Coated Articles

U. S. Patent 2,492,561. *H. A. Eckman, assignor to Crane Co.*

A packing material suitable for the removal of the element zinc from machined zinc-coated articles whereby the latter are treated by heating said articles predeterminedly while packed in said packing material, the packing consisting of 25 to 75% iron particles as essential components, carbonates up to 10%, an amount of solid carbonaceous material not to exceed 10% and the balance an inert refractory material from the group consisting of sand and clay.

Electrolytically Polished Graphite Anode

U. S. Patent 2,494,425. *J. Bakker, assignor to Hartford National Bank and Trust Co.*

An ion discharge tube comprising an electrolytically polished graphite anode.

Chromate-Phosphate Coating for Steels and Zinc Alloys

U. S. Patent 2,494,908. *F. P. Spruance, Jr. and J. H. Thirsk, assignors to American Chemical Paint Co.*

A process for coating ferriferous and zinciferous metals which consists in treating the surface with an acid aqueous solution until a coating is formed; the essential active coating-producing ingredients of which solution are fluoride ion, dichromate ion, phosphate ion and hydrogen ion, the ions being present in amounts stoichiometrically equivalent to

	Grams per liter
Fluorine	0.9 to 12.5
Chromic acid (CrO_3)	3.75 to 60.0
Phosphate (PO_4)	2 to 285

the ratio of fluoride ion to dichromate expressed as $F:CrO_3$, being between 0.135 and 0.405; the pH of the solution being between about 1.6 and 2.2, as measured by the lowest value indicated by a glass-electrode pH meter within the first ten minutes of immersion of the electrode in the solution; and drying the coated surface.

Blast Cleaning Nozzle and Exhaust

U. S. Patent 2,494,773. *W. H. Mead and A. C. Buchan, assignors to said Mead.*

In an operating head for a blast-impelling, suction-removing, surface-treating apparatus, said head including a hollow housing open at its lower end where it faces the work surface, the bore of said housing also being in communication with a suction line and having means therein connected with a blast line and for directing said blast out through said lower end, the combination therewith of a circular brush secured around the lower end of said housing to provide a maze-like, air-permeable, impeding means and an inner impermeable member secured around said housing between said housing and said brush, said member having air passages through its lower periphery.

Chromate-Arsenate Coating for Copper, Brass, Terneplate, Magnesium, Steels and Zinc Alloys

U. S. Patent 2,494,909. *F. P. Spruance, Jr. and J. H. Thirsk, assignors to American Chemical Paint Co.*

A process for coating copper, brass, terneplate, magnesium, zinciferous and ferriferous surfaces which consists in treating the surface with an acid aqueous solution until a coating is formed; the essential, active coating-producing ingredients of which solution are fluoride, dichromate, arsenate and hydrogen ions, the ions being present in amounts stoichiometrically equivalent to

	Grams per liter
Fluorine	0.9 to 12.5
Chromic acid (CrO_3)	3.75 to 60.0
Arsenate (AsO_4)	3.24 to 462

the ratio of fluoride ion to dichromate, expressed as $F:CrO_3$, being between 0.135 to 0.405; the pH of the solution being between about 1.4 and 2.8, as measured by the lowest value indicated by a glass-electrode pH meter within the first ten minutes of immersion of the electrode in the solution; and drying the coated surface.

Chromate-Phosphate Coating for Aluminum

U. S. Patent 2,494,910. *F. P. Spruance, Jr., assignor to American Chemical Paint Co.*

In a process for coating metal chosen from the group consisting of aluminum and alloys thereof in which aluminum is the principal ingredient with an adherent coating, the step which consists in subjecting the metal to the action of an aqueous solution the essential active coating-producing ingredients of which are fluoride ion, dichromate ion and phosphate ion, the ions being present in amounts equivalent to

	Grams per liter
Phosphate ion	1.5 to 300
Dichromate ion (Cr_2O_7	3.5 to 150
Fluoride ion	0.75 to 95

the ratio of the dichromate ion to fluoride ion expressed to $CR_2O_7:F^-$ being between 1:0.375 and 5.45 and the pH of the solution measured colorimetrically lying between 3.2 and 7.0.

Continuous Anodizing of Sheet

U. S. Patent 2,494,954. *J. F. Mason and F. H. Hesch, assignors to Reynolds Metals Co.*

Apparatus for the continuous anodizing of sheet metal of indefinite length which comprises a tank for an anodizing solution, power driven roller means for drawing the sheet of metal through the solution, electric means for rendering the sheet anodic, two plates of non-conducting material extending across the tank and at least the width of the sheet of metal and located where the said sheet enters the solution, said plates being spaced apart and extending both below and above the surface of the anodizing solution and converging downwardly to form a narrow slot through which the sheet of metal passes, the distance between the plates at the surface of the solution being relatively wide whereby the current density at the surface is relatively low and striations are prevented from forming on the resulting anodic coating, and a cathode below the said non-conducting plates.

Bright Copper Plating Bath

U. S. Patent 2,495,668. *K. S. Willson and D. G. Ellis, assignors to The Harshaw Chemical Co.*

An aqueous, alkaline electroplating bath which comprises an aqueous medium to which has been added a metal ion yielding material essentially consisting of copper cyanide in concentration from 30 to 150 grams per liter, a sufficient amount of sodium cyanide

to produce from 2 to 12 grams per liter of free cyanide in the solution and an amount of a brightening addition agent of the class consisting of B-mercapto ethanol, dithiodiglycol, B,B′ dihydroxyethyl sulfide and thioglycollic acid sufficient to permit a brilliant cathodic deposit of copper upon the passage of an electric current from a copper anode to a cathode through the bath, the concentration of said brightening addition agent being from 0.05 gram per liter to 10 grams per liter in the case of B-mercapto ethanol, from 0.04 gram per liter to 1.8 grams per liter in the case of dithiodiglycol, from 0.007 gram per liter to 35 grams per liter in the case of thioglycollic acid, and from 1 gram per liter to 240 grams per liter in the case of B,B′ dihydroxyethyl sulfide.

Continuous Plating of Coiled Stock

U. S. Patent 2,495,695. *E. L. A. Camin and H. Kenmore, assignors to Kenmore Metals Corp.*

An apparatus for electroplating helically formed, elongated, heavy gauge metal material comprising a longitudinal series of tanks including a tank adapted to contain a cleansing solution and a tank adapted to contain an electroplating solution, a cylindrical roller extending above and along the length of the series of tanks, means for rotating said cylindrical roller, said cylindrical roller adapted to hold a helical series of coils of said elongated metal material to be plated so that the portions of the coils below the roller are suspended within the tanks, a second cylindrical roller for pressing each of the coils which are above said tanks at those portions of the coils which contact the upper surface of the first cylindrical roller against the surface of the said first roller so that rapid rotation of the said first cylindrical roller produces rapid rotation of the coils and causes the helix of the metal material to feed into the series of baths at one end and out of the series of baths at the other end and so that each coil is rolled under pressure as it emerges from the bath liquid, said tanks being closely spaced so that each coil of the helix has its lower portion submerged in one of the tanks, and electrical contact means adapted to ride on the coils above the surface of the electroplating tank.

Addition Agent for Zinc Plating

U. S. Patent 2,495,629. *A. E. Chester and F. F. Reisinger, assignors to Poor & Co.*

A plating bath comprising an alkaline zinc cyanide bath containing in solution a reaction product of a heterocyclic aldehyde with a carbocyclic primary amine, substantially insoluble in water, soluble in alkaline solutions and sparingly soluble to insoluble in ethyl, propyl and butyl alcohols.

In the electrodeposition of zinc, the step which comprises electrodepositing zinc from an alkaline cyanide-zinc plating bath in the presence of an alkali-soluble reaction product of a cyclic aldehyde with a carbocyclic primary amine.

Anodizing and Copper Plating Aluminum

U. S. Patent 2,495,941. *L. F. Mondolfo, assignor to Reynolds Metals Co.*

The method of electroplating copper on aluminum which comprises immersing at least two aluminum articles in a water solution of sulfuric acid and copper sulfate, applying an alternating current to the two articles as electrodes and forming an anodic coating thereon, discontinuing the use of alternating current, connecting the articles in parallel as cathodes and a body of copper as anode to a source of direct current and depositing copper on the articles.

Electropolishing Bath for Stainless Steel

U. S. Patent 2,496,299. *S. A. Mansfield and C. E. Bishop, assignors to Celanese Corp. of America.*

Process for the production of stainless steel spinning jets having an inner face and an outer face and provided with a plurality of fine orifices for filament-forming operations, which consists essentially of the steps of forming depressions in the inner face of said jet at those points at which orifices are to be provided, imparting a smooth finish to said inner face by subjecting the spinning jet to electrolytic anodic action in an electrolytic bath consisting essentially of 40 to 50% by volume of orthophosphoric acid and 50 to 60% by volume of glycerine employing a current density of 0.1 to 2.0 amperes per square inch, the temperature of the electrolytic bath being maintained between about 40°C. to about 125°C. during said electrolytic treatment, drilling orifices through the jet faces where the depressions are formed, and again subjecting the drilled jet to electrolytic anodic action in the said electrolytic bath to impart a smooth finish thereto.

Increasing Absorptive Properties of Anodized Coatings

U. S. Patent 2,496,649. *W. G. Zelley, assignor to Aluminum Co. of America.*

The method of rendering an oxide coating chemically produced on an aluminum article in an alkaline solution more absorptive to dyes which comprises immersing said article in a solution consisting essentially of water and about 1 per cent by weight of an ammonium compound from the group ammonium chloride, ammonium nitrate, ammonium formate, ammonium acetate and ammonium sulfamate as the coating modifying component and maintained at a temperature above about 170°F. and a pH of about 5 to 7.5, for at least about 5 to 10 minutes.

Immersion Brass Plating

U. S. Patent 2,496,845. *A. R. Balden and L. M. Morse, assignors to Chrysler Corp.*

A bath for depositing a brass coating by chemical displacement comprising from approximately 8 oz. to 45 oz. per gallon sodium zincate, from approximately 25 oz. to 125 oz. per gallon of sodium hydroxide, from approximately .1 oz. to 6 oz. per gallon of copper cyanide, from approximately .1 oz. to 12 oz. per gallon of sodium cyanide, from approximately .003 oz. to .1 oz. per gallon of basic lead carbonate, and the remainder water.

Fused Chromium Coating of Cast Iron

U. S. Patent 2,496,971. *S. B. Wiczer.*

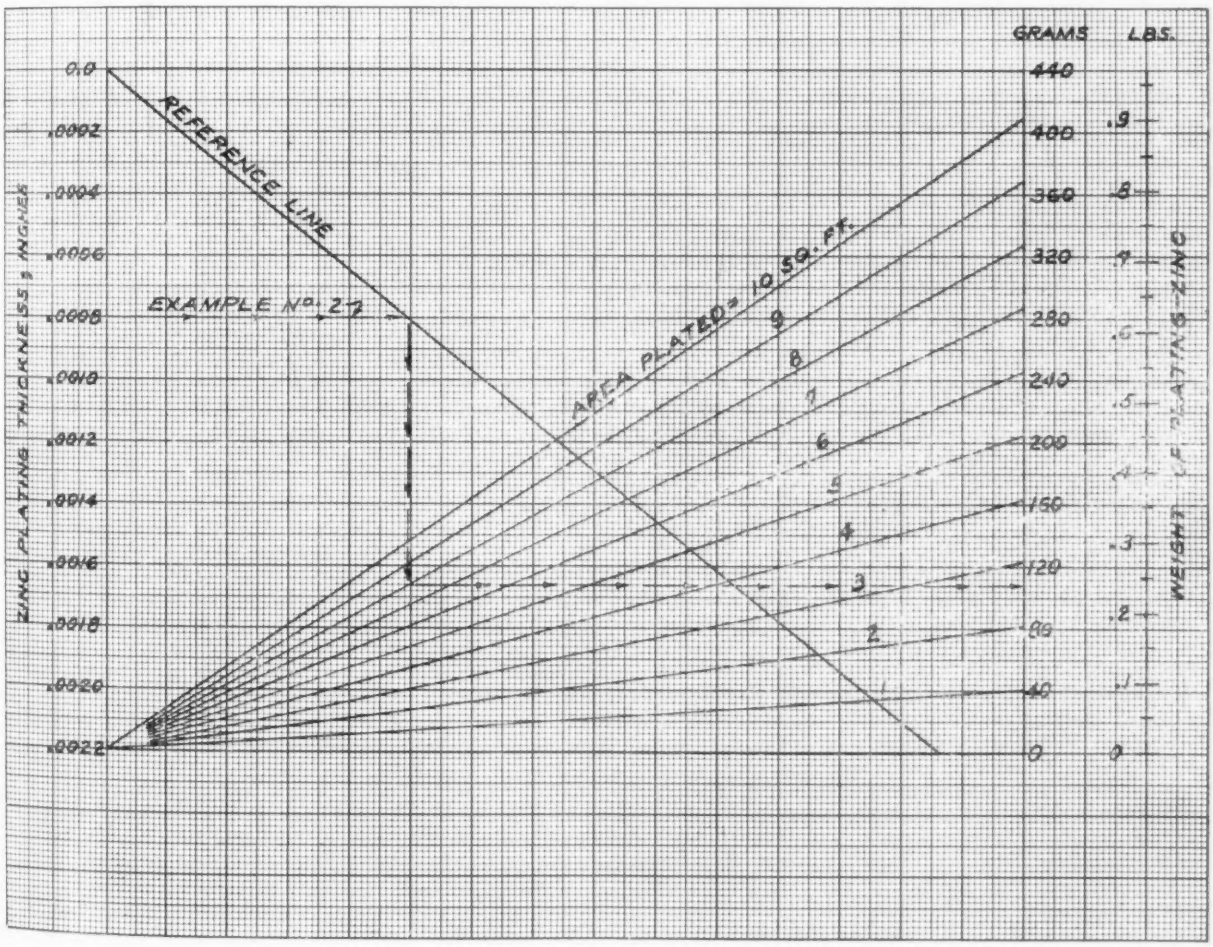
The process of coating an iron casting which comprises, heating the casting until it is white hot, allowing the casting to cool just sufficiently to harden, evenly applying a mixture of two parts by weight of chromic oxide powder and one part by weight of aluminum powder to a surface of the hot casting, whereby a reaction occurs on the surface of the hot casting, between the chromic oxide and aluminum powder mixture to provide a metallic coating on the casting.

Engineering Information Useful In
Designating Metallic Surface Treatments

Engineering Data Sheet

Calculating Metal Cost in Zinc Plating

With the aid of the chart below it is a simple matter to calculate the metal cost of depositing a given thickness of zinc on a known surface area. The example shown by the dotted line illustrates the method for calculating the total weight of zinc used in plating .0008" of zinc on a surface area of 8 square feet. The total weight of zinc is then multiplied by the present price for zinc anodes to get the total cost. For areas larger than 10 square feet, simply multiply by the proper factor.

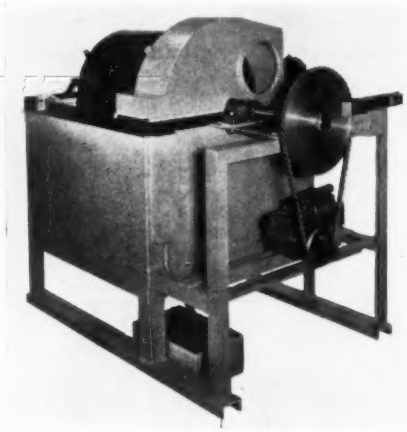


Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Chromium Plating Barrel

United Chromium, Inc., 100 East 42nd St., New York 17, N. Y.



Now available for prompt delivery is the 24-inch, batch-type Unichrome chromium plating barrel. Used for hard and decorative plating of small parts which are expensive or difficult to plate in baskets or on racks, this barrel offers lower cost plating with fewer rejects, according to the firm.

The insulated steel cylinder of the barrel is 24 inches in diameter and 20 inches long. The cylinder is mounted in a 150 gallon, insulated steel tank with all bearings, connections, and brush contacts made outside the barrel. The cylinder is rotated by an electric motor through reduction gears, while the anode is stationary inside the cylinder. A temperature control coil, electric stirrer, exhaust hood, unloading device, and drip pan are included.

The capacity of the barrel depends upon the size and shape of the work. A large Eastern manufacturer plates between 100,000 and 500,000 pieces per eight-hour day in one barrel, it is claimed. Approximately 5,000 wood screws, ½ inch long, weighing 10 pounds can be chromium plated in 10 minutes, according to the firm.

A special Unichrome self-regulating high speed chromium plating solution is used in the barrel. Maintenance of the self regulating solution is simple; water and Unichrome S.R.H.S. salts being the only additions necessary. Under normal operation, no chemical analysis of the solution is required. Additions are made on the basis of solution density determinations made with a hydrometer.

Further information concerning the Unichrome chromium plating barrel may be obtained by writing.

One-Piece Lead Anodes

Rochester Lead Works, Dept. MF, 380 Exchange St., Rochester, N. Y.

This firm announces their new one-piece lead anode for plating. The patented design incorporates ribbed construction and an integral hook, thus eliminating joints. An increased surface area of almost 2-1 is claimed over flat type anodes. Any length can be supplied, as can anodes having integral handles for easy lifting. The firm also re-purchases anode residues of their make. Further details may be obtained by writing to the above address.

Cyanides From New Source

Kraft Chemical Co., Dept. MF, 917 W. 18th St., Chicago 8, Ill.

Gerald G. Kraft, Sales Manager of *Kraft Chemical Company*, Chicago, has announced the recent addition to the Kraft line of potassium cyanide, copper cyanide and zinc cyanide of exceptionally high quality.

These materials are being obtained through new production, which gives finishers and other commercial users a more flexible supply condition. The items named are companion products to the high quality sodium cyanide which the Chicago manufacturer and distributor of chemicals, colors and oils began to market earlier this year. Full information regarding all these cyanides, of which stocks are being maintained at several points in the Mid-West, is available upon request.

Oil-Immersed Selenium Rectifier for Electroplating

General Electric Co., Dept. MF, Schenectady 5, N. Y.

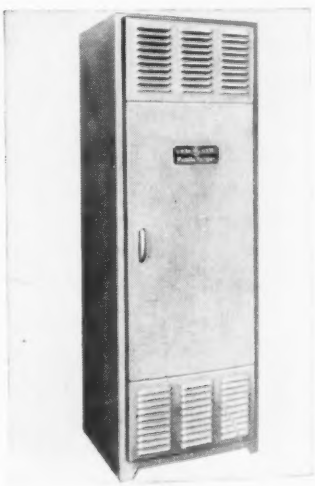
A new oil-immersed selenium rectifier especially designed for electroplating, particularly barrel plating, has been announced by the General Electric Company's Lighting and Rectifier Divisions.

Believed to be the first standard rectifier using hermetically sealed selenium stacks to withstand the corrosive atmosphere of a plating room, the new unit is available in two models:

6/12 volts, 1500/750 amps, 230-460 volts a-c, 60 cycles, three phase.

9/18 volts, 1500/750 amps, 230-460 volts a-c, 60 cycles, three phase.

The new rectifier consists of a transformer, fan, and 12 rectifier stacks ar-



ranged in a steel casing. Each stack, hermetically sealed in an oil-filled can, contains matched selenium cells connected in parallel through heavy internal bus bars to mechanically sealed terminals, utilizing Neoprene for sealing and glazed porcelain for insulation.

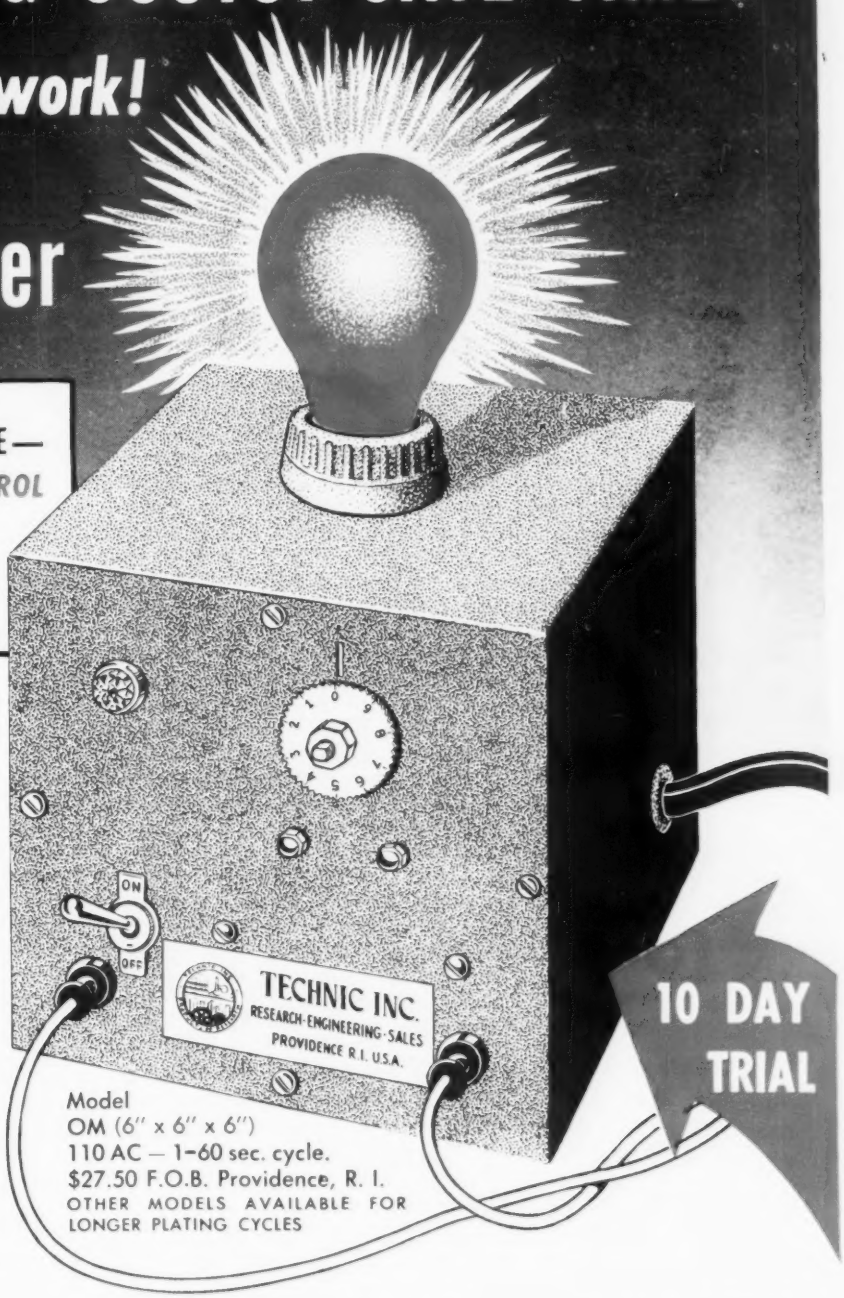
The fan mounted in the top of the unit blows air downward so that it passes first over the rectifiers and then

CUT PLATING COSTS! SAVE TIME!

Eliminate Guesswork!

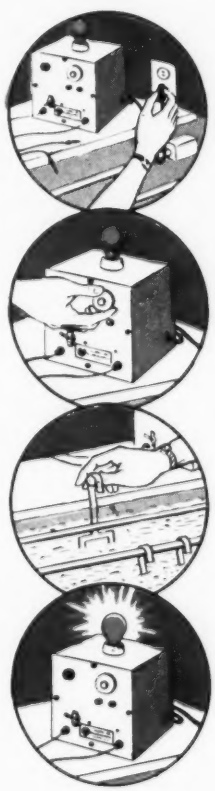
WITH THE

Techni-Timer



NOW **FOR THE FIRST TIME—**
AUTOMATIC TIMING CONTROL
IN THE PLATING OF RHODIUM, GOLD AND GOLD ALLOY SOLUTIONS!

SET UP AND OPERATING IN LESS THAN A MINUTE!



Plug into electrical outlet. Clamp lead wires to tank rheostat.

Set dial for desired plating time. *No need to reset unless cycle change is required.*

Insertion of work in the tank *automatically* starts timing cycle.

Red light signals completion of cycle — AND removal of work *automatically* resets the timer to the same cycle — ready for the next batch.

Model
OM (6" x 6" x 6")
110 AC — 1-60 sec. cycle.
$27.50 F.O.B. Providence, R. I.
OTHER MODELS AVAILABLE FOR LONGER PLATING CYCLES

No more clock-watching! No more tiresome setting of audible timers! The inexpensive, automatic TECHNI-TIMER is the long-awaited answer to the proper control of short cycle plating times.

The new TECHNI-TIMER takes the guesswork — and the work — out of short cycle timing. It cuts plating costs by preventing overplating . . . cuts operating time and speeds batch output by eliminating manual resetting. Its automatic action does not interfere with or cut off plating current.

ORDER NOW! Use the TECHNI-TIMER for 10 days. If not completely satisfied that the TECHNI-TIMER will out-perform ordinary timers — and save you money — return to Technic Inc. and your money will be promptly refunded.

TECHNIC INC.

39 SNOW STREET, PROVIDENCE, R. I.

SUPPLIERS OF A FULL LINE OF RECTIFIERS, PERIODIC REVERSE UNITS, ETC.

Old Fashioned

Methods Cause Delay—and

COST YOU MONEY

SIEFEN

Spray Compounds are Modern as the Future — They Cut Production Costs — Increase Quality and Profits!

Spray composition is fast replacing bar composition because it is faster and more economical! J. J. Siefen, a leader in the field for over 20 years has created the perfect SPRAY COMPOUND for your particular type of buffing or polishing work.

THE Siefen System
SPRAY EQUIPMENT
SPRAY COMPOUNDS
SPRAY SERVICE

Our representative in your territory will be glad to help you in any buffing or polishing problem.

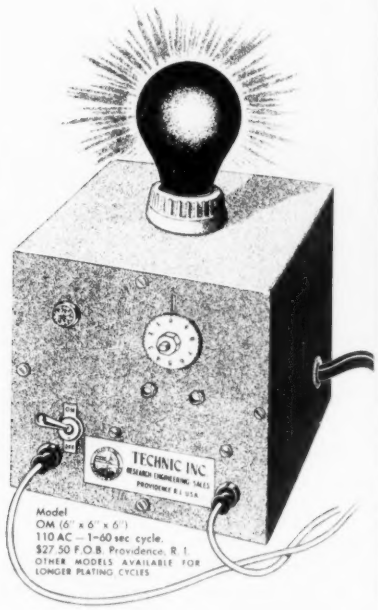
J. J. SIEFEN CO.
5641 LAUDERDALE
DETROIT 9, MICH.

over the transformer, thereby giving the rectifiers benefit of the coolest air. Each unit consists essentially of two rectifiers with individual bus bars brought out at the rear. These may be connected in series or parallel to give full current at normal voltage or half current at double voltage.

The transformer is arranged so that the primary may be connected for 230- or 460-volt circuits. Taps are provided to compensate for line voltage variations.

Automatic Timer for Plating

Technic Inc., Dept. MF, Snow St., Providence, R. I.



Technic Inc., suppliers of a complete line of rectifiers, periodic reverse units and other items used in plating operations, has announced the development of an automatic timing control for the plating of rhodium, gold and gold alloy solutions.

Called the "Techni-Timer" the new unit, which is only 6" square, is claimed to be the long-awaited answer to the proper control of short cycle plating times. It is set up and operating in less than a minute. After being plugged into an electrical outlet, lead wires are clamped to the tank rheostat. The operator then sets the dial for the desired plating time. After this initial setting there is no need to reset unless a cycle change is required.

Insertion of the work in the tank automatically starts the timing cycle. Completion of the cycle is signalled

by a red light. Removal of the work automatically resets the timer to the same cycle, ready for the next batch.

According to Technic, the new timer takes the guesswork out of short cycle timing and eliminates the tiresome setting of audible timers. It is also claimed to cut plating costs by preventing overplating; cuts operating time and speeds batch output by doing away with manual resetting. Its automatic action does not interfere with or cut off plating current.

Anodizing Tank

E. H. Langsenkamp Co., Dept. MF, 227 East South St., Indianapolis, Ind.

A newly developed tank for anodizing aluminum, primarily constructed to give continuous service for three years under normal operations, is announced by the above firm.

Designed especially for the anodizing process, the tank is reinforced within itself (the welds at all four corners over-lapping) thereby keeping buckling to a minimum, preventing galvanic action, and lengthening the life of the tank, it is claimed.

Available in all sizes, in stainless steel, aluminum, or copper, the tank is said to effect valuable savings in operation, time, and production. A lead lining is available when desired.

Langsenkamp Company also features a Weldless 16-Tumbler Rack designed for use in anodizing tanks measuring 18" wide by 42" deep. Use of the racks eliminates poor conductivity, increasing rack service 50%, it is said. Racks are fabricated from 3/8" by 3/4" 24 St. aluminum.

Small Sized Water De-Ionizer

The LaMotte Chemical Products Co., Dept. MF, Towson 4, Baltimore, Md.

To meet the pressing needs of those who require, from time to time, small amounts of chemically pure water, and in instances where elaborate types of equipment for such purposes would be costly and impractical, the *LaMotte*

For Any Plating Solution
Any Quantity

use an INDUSTRIAL Filter

100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

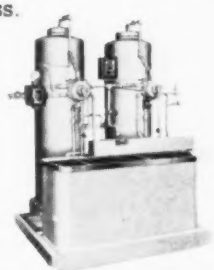
You save many ways . . .

Here's how Industrial filters keep down the cost of plating jobs—The flow rates of Industrial filters are based on the actual plating solutions involved. You know the capacity you get. In the filtration of plating solutions there is more than just the filter. With Industrial you get an adequate filter with slurry tank, motor driven pump, valves and fittings in a complete package with one, undivided, experienced responsibility—with space requirements at a minimum.

The labor, down time, and the inconveniences of cleaning, replacing the filter media, and reassembling the filter for every new filter cycle—all are eliminated by the Industrial Air-Wash Cleaning Method available for all models. It is necessary to remove the cover only when new filter cloths are installed. With Industrial filters, a clarified plating solution is always assured.

The engineering, design, and construction of Industrial filters have proved out in long service and low maintenance costs. Industrial has the experience and is large enough to handle your filter requirements. Since 1927 filters and filtration systems have been an important part of our business.

INDUSTRIAL Water Demineralizers



A Two-Bed INDUSTRIAL Water Demineralizer. Standard two-and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.

for **No stains after hot rinse. No unwanted precipitates in solutions.**

Write for full information and recommendations

FILTERS Pressure Type · PUMPS Centrifugal · CORROSION TESTING APPARATUS Salt Fog • Humidity

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RUBBER DIVISION Vulcanized Linings • Molded Products · WATER DEMINERALIZERS

Start Clean... Stay Clean!

for best results in home-canning or metal plating

No housewife would risk all the work of preparing peaches for canning by putting the fruit into jars that might not be quite clean. It is just as silly to risk wasting the time, labor, and expense involved in cleaning metal for plating by putting your work into a bath of questionable purity.

Start clean . . . *stay* clean! Use Red Label Darco S-51 regularly. Darco adsorbs impurities to *its* surfaces before they can cause trouble on the surface of freshly cleaned work.

Is your plating bath as clean as the water in your final rinse?

Darco is especially treated for use in plating — *the only carbon that meets the benzol-mercury test!* Place an order for Red Label Darco S-51 today. *Don't accept substitutes* — practically all leading suppliers carry Darco.

DARCO CORPORATION
60 East 42nd Street, New York 17, N. Y.

Co. has designed, and now offers for this purpose, their new Filtr-Ion Unit.

They are made entirely of plastic, are inexpensive, and entail no installation or operation costs, it is claimed. They may be used continuously or intermittently, as desired.

These units involve the simple principle of passing the raw water through a bed of specially prepared and adjusted deionizing resin, thereby producing chemically pure water of the quality of triple distilled water, and with a pH value of about 7.0. Each unit will deliver up to 10 gallons of chemically pure water (i.e., free from ionic solids), depending on the mineral content of the raw water supply, it is claimed.

New-Type Air and Water Rinse Gun

Turco Products, Inc., Dept. MF, 6135 South Central Ave., Los Angeles 1, Calif.

The technical equipment division of Turco Products, Inc., leading manufacturers of industrial cleaning compounds, recently revealed details of their new air and water rinse gun.

Precision-built for high operating efficiency at minimum cost, the new Turco gun has a unique feature—the air and water systems are controlled separately of each other. With this new feature, the operator can adjust either air or water spray to the most exacting degree, it is claimed.

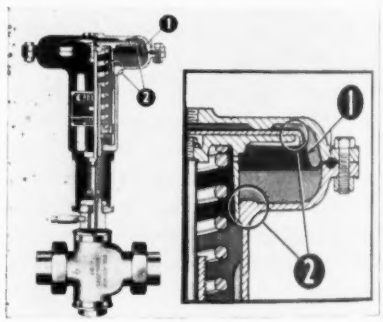
Called the "Air and Water Rinser," the new gun uses hot or cold water, connects to a regular air and water supply, has a built-in hang-up hook, is engineered to eliminate troublesome back-splash. Built to comfortably fit the operator's hand, the new gun makes difficult rinsing easy, almost effortless, according to the firm. The heaviest dirt and grease can be blasted from even the finest finish, safely and swiftly, it is claimed.

The rinser is recommended for use in rinsing after application of emulsion precleaners, degreasing solutions, paint strippers and other cleaning materials. It is adaptable to cleaning industrial equipment, paint spray booths, aircraft and aircraft equipment, automotive equipment and a wide range of other cleaning operations.

Air or Water Operated Control Valve

Powers Regulator Co., Dept. MF, 2779A Greenview Ave., Chicago 14, Ill.

This firm announces their new diaphragm operated valve for controlling the flow of steam, water, oil, or gasses below 250 psi. pressure. It is available



in sizes from ¼" to 8". Features claimed for this valve are positive sealing through the use of a molded neoprene diaphragm, ball bearing nonrising adjusting screw, preformed lubricated metallic stem packing, and only four bolts to join the special cast iron top and bottom housing. A variety of valve bodies are available, including single and double seat; double unions; flanged ends; direct, reverse acting, and 3-way valves.

Universal Spindle Stand

Vonnegut Moulder Corp., Dept. MF, 1819 Madison Ave., Indianapolis, Ind.

This firm, manufacturer of the Vonnegut brush-backed polishing head,

announces development of a new spindle stand which is universally adjustable. Designed for finishing and polishing work which is to be pushed across a table by hand or by power feed, the stand's motor can be turned to point the spindle straight up, straight down and through all of the 180° between these extremes. It has

20" of vertical adjustment and also 5" adjustment lengthwise of the spindle. With this three-way combination of adjustments, the firm points out, a head can be brought into proper relation with any surface of any pattern when the spindle stand is located next to a feed bed or table on which the work pieces are being advanced. In addition to the three adjustments mentioned above the motor and its support may be rotated around the vertical column. On narrow patterns or edgework the full 4" width of abrasive can be used by resetting the head with the 5" longitudinal adjustment.

The laminated wood table adds to the versatility of the machine. Guide pegs or an additional fence—to channel the stock between two fences—are easily attached and removed.

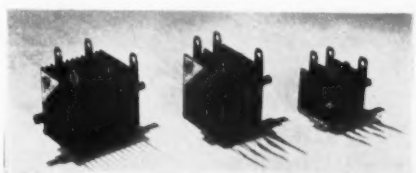
When used with power feeding mechanism, the standard table and its supporting arm are omitted, allowing free rotation of the motor and its support about the vertical column. Flexible arrangement of multiple stands is thus permitted. For further information write the manufacturer.

Magnesium-Copper Sulfide Rectifier Stacks

Electronic Rectifiers, Inc., Dept. MF, 2104 Spann Ave., Indianapolis, Ind.

Three new sizes in magnesium-copper sulphide dry disc rectifiers have been introduced by this firm. New models include the H-12, rectifier with four to two amperes capacity, the FT-12 with six to four amperes capacity, and the FS-12 with ten to six amperes capacity. These new rectifiers have been designed for use in small battery chargers and trickle chargers, in addition to other low voltage DC power supply applications.

They are typical of other Lektron rectifiers in that they have instant operation from temperatures as low as minus 40°F. to 284°F. They are rugged mechanically and electrically and are claimed to be unaffected by atmospheric conditions. The output of Lektron rectifiers is said to remain relatively uniform over a long operating life and they can be operated by convection cooling or forced air.



The firm also manufactures a heavy duty line of rectifiers with magnesium radiator plates with capacities from 50 to 50,000 amperes and up to 60 volts DC.

Recovering Chromic Acid from Rinses

The Pfaudler Co., Dept. MF, Rochester 3, N. Y.

This firm announces the development of a glass-lined distilling system that can be used to evaporate chromic

Users of Hammond Junior Automatics report 3 to 7 times faster finishing than hand methods. The Operator merely loads and unloads the machine, result . . . . faster, better and more uniform finishing, more pieces per hour with less operator fatigue.

SEND SAMPLES: Send us one finished and several rough samples. You will receive a complete Engineering Report and Production Analysis without obligation.

Hammond
of KALAMAZOO
Good Machinery Since '82

Hammond Machinery Builders INC.

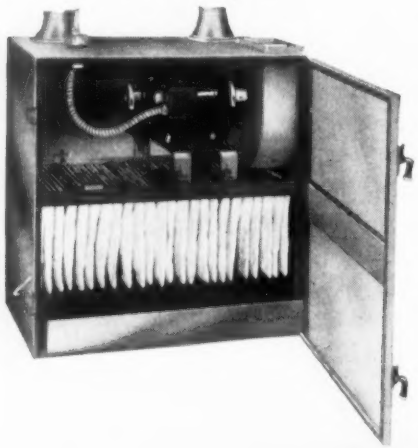
1601 DOUGLAS AVENUE ★ KALAMAZOO, MICHIGAN, U. S. A.

HUSKY
and
FAST!

Long trouble-free service and ease of operation are the prime requisites for equipment of any kind.

HISEY Buffers - Polishers embody these features to such extent that they afford lowest cost per year with maximum production.

They are made from small bench types up to 30 H.P. Pedestal types. There is a size and type particularly suited to your requirements. Let us show you.



These new HISEY Dust Collectors fill a long felt need for efficient dust collecting at reasonable cost. They are made in four sizes which cover most applications and can be supplied with new machines or for machines already in service.

CATALOG 71FC FREE ON REQUEST

Hisey THE HISEY-WOLF MACHINE CO.
CINCINNATI 8, OHIO
Division of The Cincinnati Electrical Tool Co.

acid solutions, as well as other highly corrosive chemical solutions, to recover the valuable chemicals contained therein, and to alleviate some of the pollution problems attending the dumping of solutions in municipal sewers. In addition to chemical recovery, the system makes available a supply of pure distilled water for solution make-up, etc. . . By utilizing vacuum distillation, the high boiling temperatures of most solutions are considerably lowered and many chemicals decomposed by high heat can be recovered, it is claimed. The firm states that one large firm has already recovered 25,000 lbs. of chromic acid through the use of this equipment in five months.

Standard Carbon Brushes

National Carbon Div., Union Carbide and Carbon Corp., Dept. MF, 100 E. 42nd St., N. Y. 17, N. Y.

A distinctly new method of merchandizing carbon brushes is announced by this firm, in their establishment of "*National*" *Carbon* Standard Brushes. This radical move is claimed to insure not only a better product, at a better selling price, but also an adequate stock at all times for prompt shipment, thus providing a very real saving to the purchaser.

The Standard Brushes in the list include some of the most popular items for Diesel-electric locomotive service; P.C.C. car motors; Westinghouse SK motors and generators; Westinghouse motors and generators having tandem holder; and General Electric CD motors and generators.

These Standard Brushes, to be sold at a flat price, are those in such demand that they can be produced in large quantities, packed in Standard packages, at the same price per brush regardless of the quantity purchased, provided they are purchased in Standard package quantities or multiples thereof. The Standard packages, in lots of 50, 100 and 250 brushes dependent on type of brush, are designed for convenient handling in stores and shipment.

Grades, shunt connections and other specifications for each Standard Brush, have been carefully studied to provide the most satisfactory general performance, the widest latitude of application and the lowest consistent selling price, it is claimed.

New Hand Threader for Karbate Pipe

National Carbon Div., Union Carbide & Carbon Corp., Dept. MF, 30 E. 42nd St., N. Y. 17, N. Y.

A new hand threading tool for use with Karbate impervious graphite pipe has been announced by this firm.

The new tool eliminates the need for an expensive lathe operation and is easy to carry, making it possible to cut, thread and install pipe right on the job with a considerable saving in time and expense, and extreme flexibility of working procedure, it is claimed.

The new hand threader cuts Karbate impervious graphite like wood, producing clean, sharp threads, and it is inexpensive to buy.

Complete information may be obtained and arrangements made for a demonstration of the threading tool by writing to the above address.

Water Soluble Gold Plating Salts

Platers Research Corp., Dept. MF, 59 E. 4th St., N. Y. 3, N. Y.

Auralite* water-soluble gold alloy plating salts is the newest product developed by this firm.

Auralite gold alloy salts are completely water-soluble, and are available in all the popular shades of Yellows, Hamiltons, Lilacs, Pinks, Greens, etc. Matched shades for individual firms are also available.

Heretofore gold alloy solutions were obtained only in bulky concentrates usually containing one ounce of gold in about one gallon of water. They were subject to breakage and spillage. Auralite salts can be stored in a safe.

The gold alloy plating solution is made up by dissolving one bottle of Auralite salts (containing one ounce of gold) into four gallons of water. A stock solution can also be made of any desired concentration for replenishment.

Any one familiar with gold plating technique can easily operate these non-critical solutions made from Auralite alloy salts, it is claimed.

**Auralite—trade mark patent pending.*

Liquid Polishing Compositions

Lea Mfg. Co., Dept. MF, Cherry Ave., Waterbury, Conn.

This firm, manufacturers of polishing and buffing compounds and platers' supplies, announces two new products:

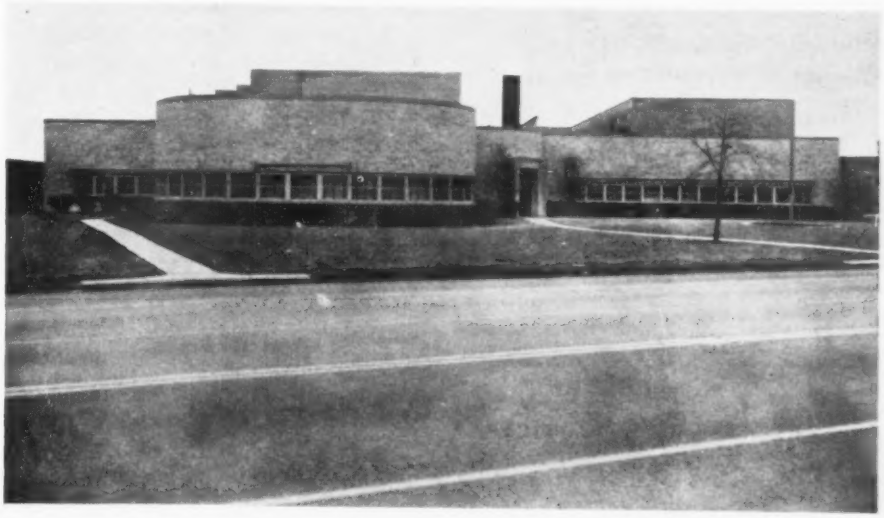
1 *Leabrament:* a greaseless, non-flammable, quick drying, liquid abrasive, for burring and polishing, available in grit sizes from 100 to fine micron. It can be sprayed or brushed on polishing and buffing wheels and is suitable for hand or automatic production methods. Also suitable for renewing worn abrasive belts.

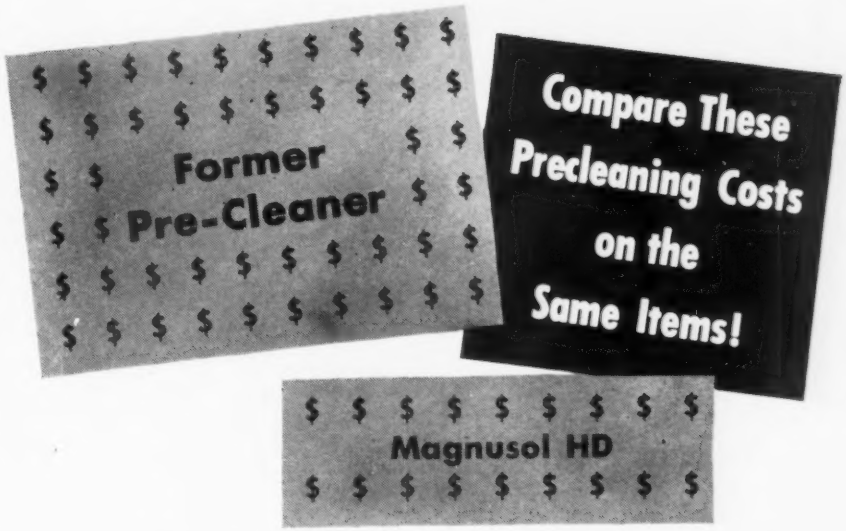
2. *Leament:* a liquid polishing cement featured by flexibility and long life. It can be sprayed or brushed on the wheel prior to heading up with loose abrasives.

Business Items

Industrial Filter Co. Moves to New Plant

The general offices and plant of the *Industrial Filter & Pump Mfg. Co.* has moved from 1621 West Carroll Avenue to newly acquired location at *5900 Ogden Ave., Chicago 50, Ill.* The much larger manufacturing demand for the company's filters, demineralizers, heat exchangers, corrosion test cabinets, unit spray washers, vulcanized linings, and molded-rubber products. This new plant will enable the





IN the plating shop where an emulsion-solvent cleaner was used to preclean a wide variety of steel parts before final alkaline cleaning for plating, the material formerly used cost $180.00 a month.

They shifted to Magnusol HD—a concentrated material, mixed 1 to 8 with safety solvent. Costs are now slightly over $55.00 a month! Not only do they save $125.00 a month on cleaning material costs, but parts are cleaned in 1/3 *less time* . . . and are cleaned better!

If you do plating, it will pay you to investigate the economies of precleaning with Magnusol prior to alkaline or electrocleaning operations.

MAGNUS CHEMICAL CO. • 11 South Ave., Garwood, N. J.
In Canada — Magnus Chemicals, Ltd., Montreal.
Service representatives in principal cities.

Magnus
CLEANERS • EQUIPMENT • METHODS

FOR THE FIRST TIME!

WATER SOLUBLE *GOLD-ALLOY* SALTS

PLATE WITH

AURALITE*

THE ORIGINAL WATER SOLUBLE GOLD ALLOY **SALTS**

★ Highly Purified Salts Quickly Dissolve In Water
★ No Bulky Gallon Bottles in the Way
★ No Risk of Loss, thru Breakage and Spillage
★ Salts Easily and Safely Stored Until Needed
★ Economical to Use — 4 Gallons Plating Solution from 1-oz. of Gold
★ All Popular Shades — Also Matched Shades
Pre-Plate, Hamiltons — Yellows — Lilacs — Pinks — Greens, etc.
★ Gold Content Unconditionally Guaranteed
★ Why Pay for Shipping Water — Use the Salts

*Trade Mark Pat. Pend.

PLATERS RESEARCH CONTROL + ⊖ − SYSTEMS

PLATERS RESEARCH CORPORATION

59 EAST 4th STREET NEW YORK 3, N. Y.

Lou Gagnon

company to better its service to its customers.

Rhoads New Gen'l Mgr. of Plating & Galvanizing Co.

Appointment of *Joseph E. Rhoads* as general manager of *The Plating & Galvanizing Co., Cleveland*, was announced today by *Raymond L. Round*, president.

Mr. Rhoads will be in charge of all company operations. These include complete cadmium, nickel, brass, copper and zinc plating facilities and hot dip galvanizing.

Prior to joining The Plating & Galvanizing Co., Mr. Rhoads was vice president of the Progressive Plating Corp., Elyria, O. He was also formerly associated with Brown-Lipe-Chapin Div. of General Motors, Elyria.

A graduate of Case Institute of Technology, Mr. Rhoads is married, and has one child. During the war he served in the Pacific as a naval lieutenant.

Lou Gagnon to Represent Bart-Messing in New England

The Eart-Messing Corp., 45 Morgan Avenue, Brooklyn 6, New York, is pleased to announce that *Mr. Louis V. Gagnon*, of Natick, Mass., has been appointed their New England representative. Since 1946, Mr. Gagnon had been in charge of the razor finishing departments at the Gillette Safety Razor Co. Over the past 14 years he has been associated with such other companies as United-Carr Fastener Corp., A. S. Campbell Co., and the Cambridge Plating Co. He is a graduate of Franklin Technical Institute in Industrial Chemistry and of the Lowell Institute School at M.I.T. in Mechanical Engineering. He is well known throughout New England because of his activities in the A.E.S., and has just completed his third year as president of the Boston Branch of this Society.

Kraft Chemical Enlarges Staff

Gerald G. Kraft, Sales Manager of *Kraft Chemical Company, 917 W. 18th Street, Chicago*, has announced the appointment of *Harry E. Stopek* to a sales-service position, concentrating on metal fabricating and finishing field.

Mr. Stopek, Chicago-born, took his degree in Chemistry from the University of Chicago in 1945 after a year as an exchange student at the University of South Wales, England. He has previously been connected with General Electric Co. and Hotpoint as a material and process engineer. He will headquarter at Kraft's main offices in Chicago.

Manufacturers Plating Corp. Completes New Plant

A new plant and modern installation has been completed by the *Manufacturers Plating Corp.*, at 5075 Fourteenth Street, Detroit. The move to a larger plant made possible the introduction of streamlined equipment

which includes a conveyor system. The plant has separate polishing and buffing sections.

The firm plates steel stampings and brass and zinc die castings on separate plating lines. At present, copper, nickel, and chrome plating is done for the automotive, accessories, and refrigerator industries.

Edward Kahn is general manager.

Watt New Finishing Sales Manager for F. B. Stevens

Frank Watt has been appointed general sales manager of the Metal Finishing Equipment & Supplies Div. of *Frederic B. Stevens, Inc.*, Detroit plating and foundry supply manufacturer, it was announced today by *W. H. Joseph Cluff*, president of the firm.

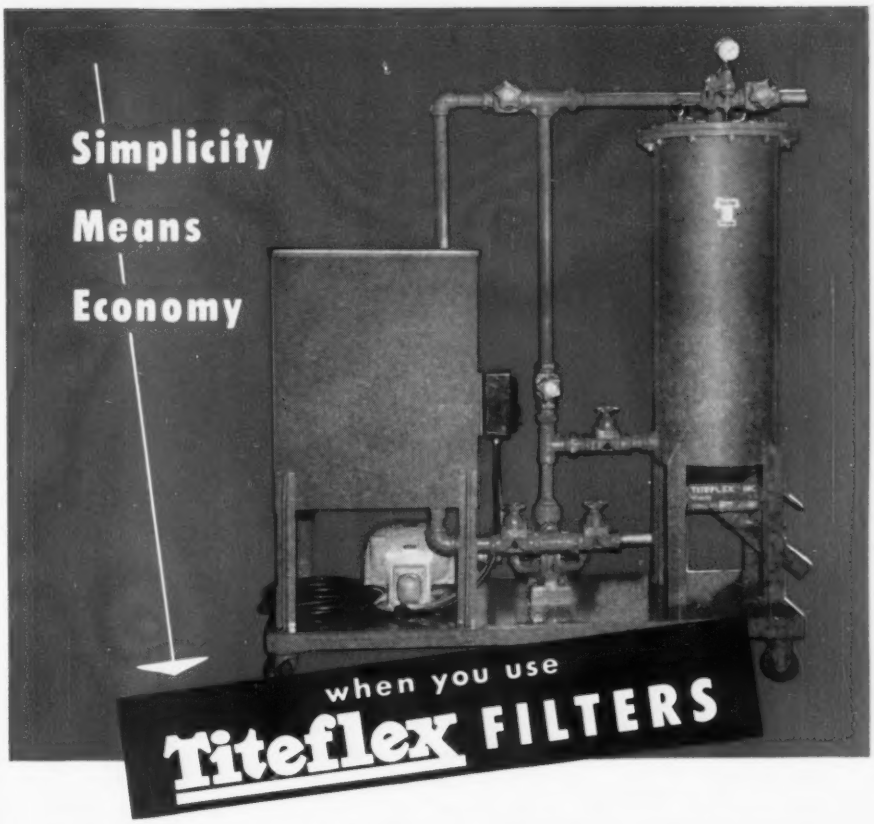
Frank Watt

Mr. Watt, who is widely known throughout the plating industry, has been a member of the sales and engineering department of the Stevens organization for the past 17 years. In addition to his new duties, Mr. Watt will also continue to contribute to the engineering and design of Stevens plating equipment.

Pennsalt Appoints Young to St. Louis Territory

The appointment of *Alfred N. Young* as sales-service representative of *Pennsylvania Salt Manufacturing Co.'s* Special Chemicals Department in the St. Louis area was announced today by *Joseph J. Duffy, Jr.*, sales manager of the department.

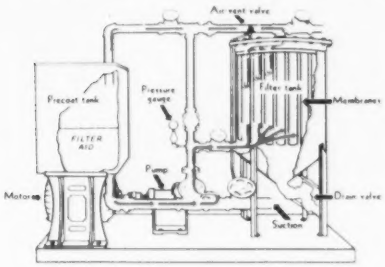
Mr. Young succeeds *Charles R. Sorber, Jr.*, who was recently transferred to the Cincinnati territory. Young, a native of the Mid-West born in Marissa, Ill., comes to Pennsalt



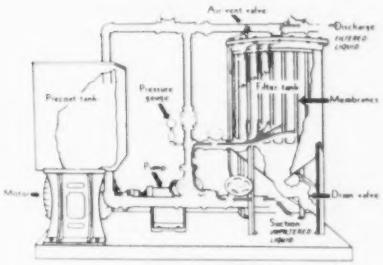
Titeflex filters are high in efficiency . . . their operation is so simple that costs are lower than with other methods. They require no replacement parts such as bags, sheets, etc. They are cleaned by an efficient backwash system, entirely eliminating waste labor. And they produce the *highest possible* degree of filtration.

Write for complete catalog showing all models

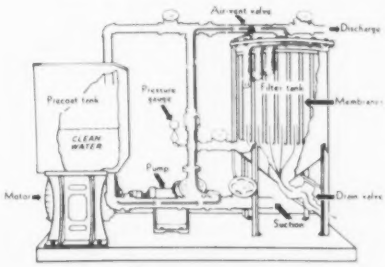
Simple 3-step operation ups efficiency, saves money



PRECOATING—Precoat of inexpensive filter-aid is built up on outside of permanent membrane cylinders.



FILTRATION—is started merely by turning proper valves. Titeflex filters can accommodate more liquid than any other equipment with equal filtration area.



BACKWASHING—Cleaning is accomplished by reversing flow of liquid through membranes. Operation is completed in minutes and it is unnecessary to remove residue manually.

Titeflex, Inc. 500 Frelinghuysen Ave. · Newark 5, New Jersey

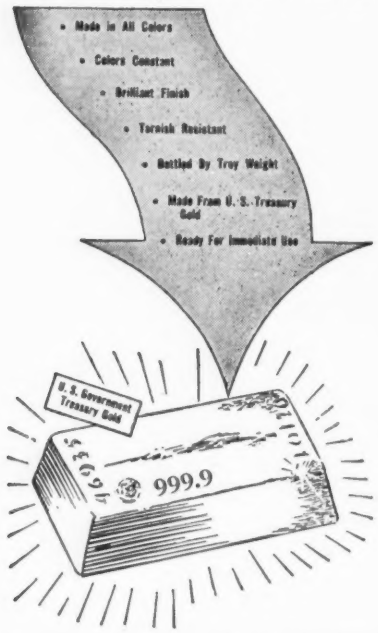
TITEFLEX FILLS PLATING REQUIREMENTS TO A . . .

DAVIS-K

GOLD and RHODIUM PLATING SOLUTIONS HEADQUARTERS

GOLD & RHODIUM

SOLUTIONS


• Made in All Colors
• Colors Constant
• Brilliant Finish
• Tarnish Resistant
• Bottled By Troy Weight
• Made From U. S. Treasury Gold
• Ready For Immediate Use
U. S. Government Treasury Gold
999.9

DAVIS-K—makers of GOLD PLATING SOLUTIONS—prepared in all colors that produce hard, tarnish-resistant, color constant deposits.

Compounded from U. S. Treasury GOLD and highest (C.P.) chemicals. Sold by troy weight—certified 100% gold content.

Solutions are simple to operate and maintain.

ANTIQUE SOLUTIONS—Deposit gold and antique in one operation—produce uniform finish—simple to operate. Your samples plated at no charge.

We welcome inquiries pertaining to precious metal plating problems. Distributors of Bakers' lustrous RHODIUM SOLUTIONS, that produce a long-lasting white finish.

"Where glittering elegance reflects lasting quality"

DAVIS-K PRODUCTS CO.

54 West 22nd Street ORegon 5-0094-5 New York 10, N. Y.

from the Harrison Lumber and Hardware Company of St. Louis. Prior to that he was with the sales department of the Grasselli Division of E. I. duPont de Nemours and during the war was a First Lieutenant in the U. S. Air Force.

R. L. Hundley New Wisconsin Manager for McAleer

McAleer Manufacturing Div., Higbie Manufacturing Co., Rochester, Mich., announces the appointment of *R. Lee Hundley* as District Manager for the State of Wisconsin and surrounding territory.

Mr. Hundley has had long experience in sales and engineering, and has been interested in modern production methods for many years. For the past twenty years he has been connected with a large copper and brass mill and fabricator and has also gained considerable experience in the ferrous and non-ferrous die-casting field. The experience gained in his former managerial capacities with metal fabricators should prove valuable in his contacts with those in the polishing, buffing and finishing field.

Mr. Hundley is a member of the American Society for Metals, as well as the A.E.S. Although he will confine his efforts principally to Wisconsin, he is also well known in Indiana, Illinois and Minnesota.

Mr. Hundley will concentrate on the sale of products manufactured by the Chemical Division of McAleer, and his office will be located at 617 North 2nd Street, Milwaukee 3, Wis.

Electric Products Co. Appoints Philadelphia Agents

The *Electric Products Co., Cleveland, O.*, has appointed *K. I. Clisby Associates* as District Representatives for the eastern section of Pennsylvania, the southern counties of New Jersey, most of Maryland and the entire state of Delaware.

Gas Range Makers Plan a Big Campaign

A comprehensive sales program aimed at selling 1½ million new gas ranges has been planned by manufacturers in this field. This is said to be the biggest promotional campaign ever attempted by the industry. The co-operative efforts of 600 utility companies, 30,000 appliance dealers, and 2,000 liquified petroleum dealers will be exerted in this program. The replacement market is the one which this promotion hopes to tap, and the campaign will explain the advantages to be gained from modern gas ranges in replacing obsolete older models. Surveys indicate that over 60% of present gas ranges are over 10 years old. Approximately 7 million dollars will be spent in promoting and advertising the program. *The American Gas Ass'n.* and the *Gas Appliance Mfr's. Ass'n.* are co-sponsors of the campaign.

Turco Appoints Two District Managers

Appointment of two new District Sales Managers is announced by *Turco Products, Inc.*, of Los Angeles, Calif., leading manufacturers of industrial chemical cleaning compounds.

J. D. Charters

"Chris" Williams

J. "Doug" Charters, District Sales Manager of the company's Houston, Texas Div., has been transferred to the Northern California sales district, with headquarters in San Francisco. He assumes this important post to fill the vacancy which occurred owing to the death of District Manager *Al Martinez* early in June.

"Chris" Williams, a native Texan, who has been assistant District Manager in Houston for the past six years, moves into the spot left vacant by Mr. Charters' transfer.

SAE Assembles Automotive Engineers for Meeting at Los Angeles August 14-16

Continuing detail improvement in the design, development, and operation of land and aircraft, and of their powerplants, will undergo technical review at the National West Coast Meeting of the *Society of Automotive Engineers* scheduled for August 14 through 16 next in the Hotel Biltmore at Los Angeles, Calif. The meeting is held with the cooperation of SAE Southern California Section.

Riddick Completes 40 Years Service With Osborn

H. T. Riddick, Assistant Treasurer and Office Manager of the *Osborn Manufacturing Co.*, Cleveland, receives the congratulations of *Franklin G. Smith*, President, (left) upon having completed 40 years continuous service with that company.

Mr. Riddick, who is 62, started in the shipping room of the Industrial Brush Manufacturing Company in 1910. After spending several years in charge of cost department and cost accounting, he was transferred to the credit department as Credit Manager in 1925. In 1946 he assumed his present position.

He is a member of the Cleveland Association of Credit Men, having been president in 1939, and the Cleveland World Trade Association.

Mr. Smith himself founded Osborn in 1892 and has continuously headed the organization during its 58 years.

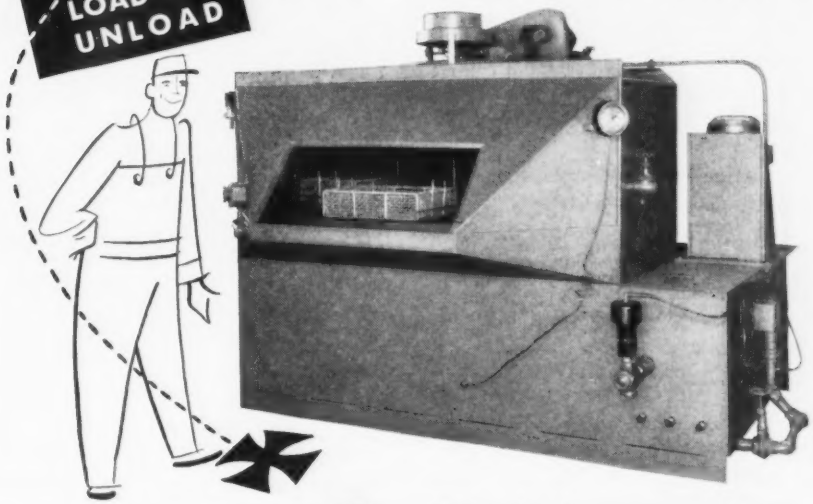
Detrex Holds Management Conference

Industrial division managers for all regions in the United States have just completed an intensive conference at the home office of *Detrex Corp., Detroit 32, Mich.*

Technical information was released on the latest developments in the design, manufacture, and application of product cleaning and rustproofing

ONE MAN OPERATION with BLAKESLEE METAL PARTS WASHERS

ONE SPOT LOAD and UNLOAD



BLAKESLEE SOLVENT VAPOR DEGREASERS
—economical, efficient—
USE LESS SOLVENT

BLACOSOLV
Stabilized Degreasing Solvent — one price, one solvent *for all metals*

Blakeslee's new washer saves labor, is economical

Just one man can keep the production line going with this time saving metal parts washer. Turn table operation permits loading and unloading in one easy pivot movement. One revolution of the washer turn table and parts come out sparkling clean for a better finishing job with fewer rejects. Blakeslee washers are designed for every type and size of plant operation. Write for the cooperative services of our engineer-trained sales representatives.

G. S. BLAKESLEE & CO.

1844 S. 52nd Avenue • Chicago 50, Illinois
New York, N. Y. Toronto, Ont.

processes, equipment and chemicals. New plans for merchandising these items, and for extending consultation and free inspection services were also covered.

Copper Anodes Available from Stock in Middle West

The Hanson-Van Winkle-Munning Co., Matawan, New Jersey, announces that arrangements have been completed for their Anderson, Indiana plant to fabricate rolled copper anodes. Shipments can be made from stock in any reasonable quantity and size anode, assuring immediate delivery.

Electroplating plants in the West are invited to take advantage of this service by sending inquiries to the nearest local H-VW-M office or to the *Hanson-Van Winkle-Munning Co.*, Anderson, Indiana.

Malone New V.P. of United Platers

Glenn H. Friedt, President and general manager of *United Platers, Inc.*, Detroit, announces that *James J. Malone*, Assistant general manager, has been promoted to Vice-President.

Through the fifteen years of his association with the above company,

James J. Malone

Mr. Malone has played a very prominent part in the growth and prestige of the company, which is recognized as being a leader in the rust-proofing and metal processing industry.

Mr. Malone is actively interested in the activities of the American Electroplater's Society and the Plating Institute, of which he is Vice-President and a member of the Board of Directors. He also is keenly interested in the affairs of the Businessmen-Boys Club in the Detroit area.

Wyandotte Purchases Pacific Chemical Co.

Purchase of the *Pacific Chemical* plant of the *American-Marietta Co.*, of Los Angeles, Calif., by *Wyandotte Chemicals Corp.*, a major producer of industrial chemicals and cleaning and sanitizing compounds, was announced today by *Robert B. Semple*, president of Wyandotte.

Wyandotte will immediately revamp the property to provide a Pacific Coast manufacturing unit to serve Wyandotte branches which have functioned for a number of years in Los Angeles, San Francisco and Seattle.

Pacific Chemical's plant and sales personnel will be absorbed by Wyandotte's Pacific Division and the Wyandotte research and technical service staffs, numbering nearly 200 persons, will become available to users of Pacific Chemical products as well as to companies using Wyandotte products.

Ford Ballantyne, Jr., vice-president, *George H. Schwarz*, vice president and controller, *Robert L. Reeves*, general sales manager of the *J. B. Ford Division*, and other executives of Wyandotte Chemicals handled the acquisition.

PARAMOUNT BRAND

FELT WHEELS

Are you finishing articles which require a wheel with a "shaped" or contoured face? Don't forget that felt wheels lend themselves to contouring probably better than any other type of wheel. Don't forget, too, you have nine degrees of hardness to choose from when you buy Bacon Felt Wheels—The Paramount Brand. Ask your supply house for Paramount Brand Felt Polish Wheels.

...TOPS IN "Contourability"

Your Supply House Can Furnish Bacon PARAMOUNT BRAND FELT WHEELS & BOBS

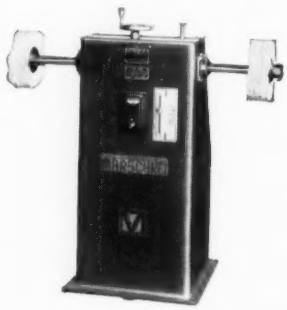
SEND FOR OUR NEW CATALOG

BACON FELT COMPANY

Established 1824

WINCHESTER "America's Oldest Felt Manufacturer"

MASSACHUSETTS Felt Does It Better



A MARSCHKE BUFFER TAILORED TO *YOU*

Goes without saying, it matters little which Marschke you select, from the standpoint of quality; a narrow one with only two bearings, or a wider one with four bearings, you'll find a stiff, true-running spindle.

The big point is: your ability to choose a Marschke to fit your needs EXACTLY. Marschkes come in a wide range of specifications: pedestal and floor stand types (as shown here), single and double end, 1 HP to 30 HP, direct or belt drive, with or without variable speed control, for wheels or for abrasive belts.

YOU tell us the problem, we'll bet we have a Marschke to fit it exactly.

VONNEGUT MOULDER CORPORATION

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UNIVERSITY OF MICHIGAN LIBRARIES

Northwest Chemical Appoints Eastern Representative

Northwest Chemical Co., Detroit, Mich., manufacturers of Northwest and Alkalume metal cleaners, pioneers in pH control of cleaning baths and originators of the Lo-Hi pH process, announce the appointment of *Stephen B. Randolph*, a chemical engineer, as their eastern representative. His address is 321 East 43rd Street, N. Y. C.

U. S. Stoneware Appoints Ass't Sales Manager

G. W. Fine

The appointment of *G. W. Fine* as Assistant Sales Manager of U. S. Stoneware's Plastic Coatings Div., has just been announced by *Howard Farkas*, executive vice-president of the company.

Mr. Fine studied Chemical Engineering at Case School of Applied Science and had been associated with Sherwin-Williams Co. for seven years, first as a laboratory technician and, upon his discharge from U. S. Army Air Force, as a member of their sales staff.

He is married, has two children and makes his home in Aurora, Ohio.

Michigan Abrasive Company Expands Operations

Max C. Jones, president of the *Michigan Abrasive Co.*, announces the purchase of the former Michigan Tool Company plant at *Eight Mile Road* and *Groesbeck Highway, Detroit*, which they are occupying in order to take care of expanding business.

The new plant was constructed in 1942. It contains approximately 65,000 square feet of floor space and is located on ten acres of ground. The company will continue to occupy their present plant at *1111 Bellevue Ave.*, where it started business in 1942.

The new plant will be equipped with specially engineered machinery, and the newly-developed resin coated abrasives will be made along with an expanded line of products, making available greater widths and more varied constructions.

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Possible cost savings in chromic acid anodizing, as well as in other metal treatments such as copper stripping, brass pickling, magnesium dips and chromium plating, are indicated through the use of oxidation-resistant cationic exchange resins. In a preliminary investigation by Mutual Chemical Company of America, certain commercial resins have been found to be stable in the presence of chromic acid. As a result, these resins may be used for removing dissolved metals from chromic acid solutions with the recovered chromic acid made available for re-use. An added advantage is in minimizing the problem of waste disposal.

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MUTUAL CHEMICAL CO. OF AMERICA — SINCE 1845

MUTUAL CHEMICAL CO. OF AMERICA

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George L. Nankervis Co. and Electromechanical Devices Co. Consolidate—Move into Modern Building

The *George L. Nankervis Co.*, internationally accepted engineers and manufacturers of plating, buffing, and metal finishing equipment, announces the purchase of the *Electro-Mechanical Devices Co.*, of Detroit, as a wholly owned subsidiary. Electro-Mechanical Devices Company (EMDCO) designs and builds dynamometers, control panels, test stands and special machinery and products to serve the needs of the automotive and aircraft industries for production and quality control equipment.

The subsidiary company will be known as the *Electro-Mechanical Devices Div.*, of the *George L. Nankervis Co.*

The two companies are consolidating their facilities in a new plant located at *19255 West Davison*. The new building provides modern facilities for factory, research, engineering, executive and general offices.

Mr. George L. Nankervis, President of the Company, announces the appointment of *Henry W. Grikscheit* as Vice President and Director of the Electro-Mechanical Devices Division. Mr. Grikscheit brings with him the entire former personnel of the Electro-Mechanical Devices Company. *Mr. H. M. Cherry*, whose experience in the metal finishing field extends over thirty years, has been appointed Vice President and Director of sales of the plating, buffing, and metal finishing division.

The former offices of the George L. Nankervis Co., were located at 5442 Second and the factory at 5408 Commonwealth. The Electro-Mechanical Devices Company was located at 49 Selden Ave., Detroit.

McMichael Forms Industrial Supply Co.

Larry McMichael, formerly head of the abrasive division of Gravert & Co., Reading, Pa., has recently formed the new firm of *Industrial Abrasives Supply Co.*, located at *208 Oak Terrace, Mt. Penn, Reading, Pa.* His partner in the firm is *Mr. Paul J. Walsh*. The firm will act as a distributor of grinding wheels, coated abrasives, loose polishing grains, buffs, polishing compositions, blasting shot, etc. . . They are handling the products of many of the leading firms in this field.

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Complete Service for Metal Finishing

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Sulphur Products Co. Inc.
Greensburg 7, Pa.

Cowles Metal Cleaning Clinic Discusses Buffing Compound Removal

Theme of the recent sales clinic conducted by Cowles Chemical Co., Cleveland, O, was "Buffing Compound Removal Was A Tough Job!" Pictured in the photo are members of Cowles' Metal Cleaner Technical Staff who participated in the discussions and demonstrations. Formal announcement of a series of new Cowles products specifically designed for efficient buffing compound removal was made at the clinic. Technical Director C. W. MacMullen, M. P. Boland and C. G. Ozar conducted a series of technical discussions and E. F. Clark, Manager of the Metal Cleaner Department, led the discussions on sales problems and policies. Reading from left to right (seated):—Fred H. Hitchcock, John W. Dobsen, Robert L. Smith, M. P. Boland and Norman E. Garman; (standing):—J. A. Barnes, Clyde E. Lowe, E. A. Lord, Technical Director C. W. MacMullen, Manager E. F. Clark, Charles W. Churchill and C. G. Ozar.

Houghton Appoints Richards in Charge of All Sales and Advertising

D. J. Richards, Vice-President of Sales, *E. F. Houghton & Co., Philadelphia*, has been placed in complete charge of all domestic and foreign sales activities since the recent death of *G. W. Pressell*, formerly Vice-President and Director of Sales. Mr. Richards will also act as Director of Advertising and will supervise the activities of the Product Development and the Sales Development Department.

Announcement is also made that *John F. Maisch* has been appointed Controller of the company, under the supervision of *Wm. F. MacDonald*, President and Treasurer.

Richmond New Asst. Purchasing Agent for U. S. Stoneware

The appointment of *Robert Richmond* as Assistant Purchasing Agent of the *U. S. Stoneware Co.*, Akron, O. and its affiliates has just been announced by *J. M. W. Chamberlain*, president.

U. S. Stoneware's affiliated compan-

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Various sizes — with and without meters.
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Just heat to 300°F and pour
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ies are: Chamberlain Engineering Corp., Colonial Rubber Co., Federal Refractories Corp., Super Machine Co., Ravenna Ceramics Corp., Republic Lead Equipment Co., Hamilton Kent Mfg. Co., and Conneaut Rubber & Plastics Co.

Free Evening Course in Electroplating

An evening lecture and laboratory course in Industrial Electrochemistry and Electroplating will be given at the Brooklyn Technical High School starting in September, 1950. There will be no charges involved in taking the course, which will cover basic chemistry, electrochemical principles, chemical analysis, and practical electroplating. Emphasis will be on laboratory work, wherein the students will carry out investigations in cleaning, electrocleaning, bright plating, and plating from all the commercial baths. Field trips to commercial plating plants and lectures by guest experts are also planned.

Anyone interested in taking this free course should contact, preferably by writing, *Mr. James P. Striffler*, Brooklyn Technical High School, DeKalb Ave. & Fort Greene Place, Brooklyn, N. Y. Early registration is suggested, as the number of persons who can be accommodated may be limited, and will be on a first come-first served basis.

Manufacturers' Literature

Ebonol Blackening Processes

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

Recently published by this firm is a new bulletin describing the characteristics and advantages of their line of blackening baths for steel, copper-base alloys, and zinc-base alloys. Two baths are available for both the zinc alloys and steels. For zinc alloys, one bath may be operated at room temperature, the other at 125-130°F. For steels, the newer Ebonol S-30 bath is claimed to provide better bulk blackening and greater wear resistance of the coating. The Ebonol-C process may be used to provide a wide range of colors besides black on copper alloys. Colors may be produced ranging from gold to blue-greens to browns in a single bath.

Corrosion Proof Linings & Floors

The Atlas Mineral Products Co. an- MF, 42 Walnut St., Mertztown, Pa.

The *Atlas Mineral Products Co.* announces the publication of their new General Bulletin MCC No. 1. This bulletin briefly describes Atlas' complete line of chemical construction materials, including: corrosion-proof linings, corrosion-proof cements, acid-proof brick and tile, corrosion-proof brick sheathings, corrosion-proof protective coatings and corrosion-proof floors. It also includes handy estimating data. Write for your copy.

Preparation and Cleaning Before Plating

Frederick Gumm Chemical Co., Dept. MF, 538 Forest St., Kearny, N. J.

This firm has issued a 45-page booklet covering various methods for cleaning and pre-treating parts before plating. Deburring, burnishing, and barrel cleaning for small parts are covered, as well as the Molex processes

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Specify Kocour Sets From Your Supplier

for racked parts. This issue also contains a supplement on methods for chemical analysis of all types of plating baths. Copies may be obtained free of charge by writing to the above address.

Direct Current Generators

Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, O.

A recent bulletin issued by this company describes and illustrates their line of direct current generators for lighting and power supplies. Features which are claimed to make these generators outstanding for this type of work are explained and illustrated, and specifications of the various types available are given. Copies may be obtained free on request to the above address.

Tin Plating Bulletin

Metal & Thermit Corp., Dept. MF, 100 East 42nd St., New York 17, N. Y.

A new technical bulletin on electrotinning is available from the above firm, producers of tin and antimony chemicals. The 24-page pamphlet gives suggested bath formulae and performance data on both potassium and sodium stannate plating solutions; contains suggestions and instructions for analysing and controlling the bath, and has a section devoted to the new high-speed tin anodes recently developed by the company. Chemists, plating plant operators and others interested in electrodeposition of tin will find this bulletin a useful and handy guide to better plating.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Chicago Branch

At the June meeting 28 members and guests were present for dinner and 44 members and guests attended the regular meeting. *Mr. Paul Glab* and *Mr. J. M. Andrus* reported on the activities of the Boston convention, and those in attendance were particularly pleased by the announcement that the Chicago Branch was awarded first prize for the best branch exhibit. The first prize for individual exhibits was won by *Klem Petrosius* and *Art Bartmann* of the Chicago Branch. Mr. J. M. Andrus's exhibit received an award of honorable mention. It was also announced that over 30 friends of the Chicago Branch attended the Boston convention.

Our speaker for the evening, *Mr. Edward I. Peters*, gave a most interesting and informative talk on the various phases of plating in the graphic arts. This well-prepared presentation was most enlightening to those in attendance who did not realize the extent of plating activities in the graphic arts, and the necessity for producing deposits wherein the physical properties of the deposit are of primary importance, with no consideration given to brightness and corrosion resistance. Following Mr. Peters's talk a lively exchange of questions and answers brought the meeting to a close.

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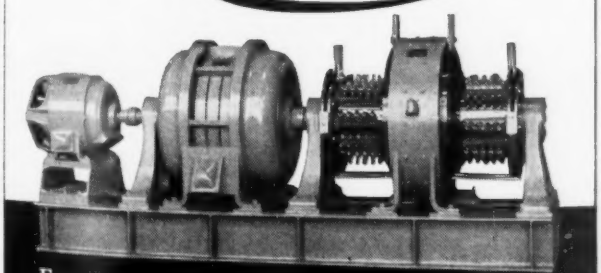

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There's a Columbia M-G Set available for your needs, whether you have a small plating bath or a large continuous strip plating line. Capacities up to 20,000 Amperes; 6 Volts and up. Dependable, performance proved, for many years. Your inquiries solicited.

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Los Angeles Branch

Los Angeles Branch of the American Electro-Platers' Society concluded the first half of its 1950 meeting schedule with a panel discussion on nickel plating which attracted an attendance of approximately 85 members to Rodger Young Auditorium Los Angeles, on the night of June 7.

The experts who discussed various phases of nickel plating, were *Earl Arnold*, of the L. H. Butcher Company's research staff, who has had much experience in nickel and chrome plating in the automotive field; *Herold Kroesche*, of the Harshaw Chemical Co., an electro-chemical engineer of national repute; and *John Manning*, of the Sundmark Supply Co.

Prior to introducing the individual speakers, Chairman Morton Schwartz presented a resume of the history of nickel plating, tracing its development back some 100 years or so. He then introduced Mr. Arnold whose assignment in the tripartite presentation was to discuss the constituents of the nickel bath.

In the 20 minutes allotted to him, Mr. Arnold gave the subject surprisingly complete coverage; He explained single nickel salts and their purpose in the bath, chloride ions, and the reasons for using boric acid. He defined the constituents of cold nickel baths, die-cast nickels, primary and secondary brighteners, and wetting agents.

The next speaker, *Mr. Manning*, concentrated his comments on operating conditions for the use of the nickel baths. He emphasized that there were four important variable which can be controlled to achieve a successful bath —the temperature, current density, and agitation. Mr. Manning explained the effect each of those variables can have on the nickel bath and how they can be controlled. The necessity for keeping up anode area was cited by Mr. Manning as one of the more important considerations for maintaining effective results.

Mr. Kroesche concluded the trilogy with a discourse on the influence of metallic impurities in the nickel bath. He went into the evil effects of iron contamination, citing loss of ductility and loss of corrosion resistance as two of the graver results of iron contamination. Among methods for getting the iron out of the bath, this speaker mentioned raising the pH and precipitating through filtering. Mr. Kroesche cited zinc as one of the impurities in nickel baths that has become a particularly aggravating problem to platers in Southern California.

An hour of spirited discussion followed.

The business session was directed by Vice-president *Roy Lostetter*, who presided in the absence of convention-bound President *Dick Wooley*. *Keith Holtzlaw*, *Harold Boyd* and *Theodore Kettner* were initiated, with *Carl Coffin* serving as initiator. Guests introduced included *Howard Arnold*, Bell Equipment Co.; *Donald Fish*, L. H. Butcher Co.; *A. L. Nation*, Norris Stamping Co.; *F. S. Johnson*, Metro-Goldwyn-Mayer Studios; and *Milton Compton*, Spence Electroplating Co.

National Chemical Exposition Set for September 5 Thru 9

The Sixth National Chemical Exposition by the Chicago Section of the

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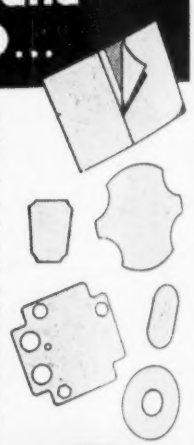

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American Chemical Society will be held in the Chicago Coliseum September 5th thru 9th, according to *Dr. Marvin C. Rogers*, Research Director of R. R. Donnelley and Sons Co., who is chairman of the committee in charge.

Details of the Exposition will be handled by the manager, *James J. Doheny*, newly appointed manager of the Chicago Section of the ACS.

Running concurrently with the 118th National Meeting of the American Chemical Society in Chicago, which will have a registration of over 10,000, it is expected that over 50,000 persons will attend the coming Exposition.

Started in 1940, largely thru the ideas and initiative of *Dr. R. C. Newton*, then Chief Chemist and now vice-president of Swift & Co., the National Chemical Exposition has grown steadily in both size and importance. An unusual feature is that it is sponsored by a local section of the American Chemical Society as a means of displaying the importance of chemistry to mankind, and to permit an exchange of ideas between chemists and industries. In addition to over 200 industrial exhibitors, the educational exhibits in the coming Exposition offer a splendid opportunity for showing new products and for the exchange of ideas.

Special features, such as the Chemical Trail Blazers, wherein new advances in chemical research or the applications of chemistry are displayed, will again be parts of the show which make it outstanding.

NATIONAL ASSOCIATION OF METAL FINISHERS

The Annual Meeting was held on Monday, June 12, 1950, at the Statler Hotel, Boston, Mass.

New officers elected for the coming year were the following:

President—*W. O. Zinn*, Chicago, Illinois.

First Vice-President—*W. F. Walton*, Attleboro, Mass.

Second Vice-President—*D. J. Griffin*, Birmingham, Ala.

Third Vice-President—*R. W. Timberlake*, Kansas City, Mo.

Treasurer — *A. Betteley*, Detroit, Michigan.

A Secretary's and Treasurer's report was presented by *R. A. Shock*, Executive Secretary. He told of an extended trip during which he was able to get started a number of local associations with excellent prospects for increasing membership in a number of cities.

New A.S.T.M. Officers Elected

At the 53rd Annual meeting of the Society held in Atlantic City during the week of June 26, the following officers were elected to head the Society for the coming year:

President—*L. J. Markwardt*, Asst. Dir. U. S. Forest Products Lab., Madison, Wisc.

Vice-Pres.—*Truman S. Fuller*, Eng. in charge, Works Lab., Gen. Elec. Co., Schenectady, N. Y.

Board of Directors—*B. A. Anderton*, Consultant, Allied Chem. & Dye Corp., Edgewater, N. J.; *Robert H. Brown*, Sales Eng., Parks-Cramer Co., Fitchburg, Mass.; *D. K. Crampton*, Dir. of Research, Chase Brass & Copper Co., Waterbury, Conn.; *Harry*

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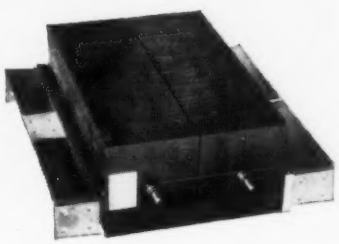

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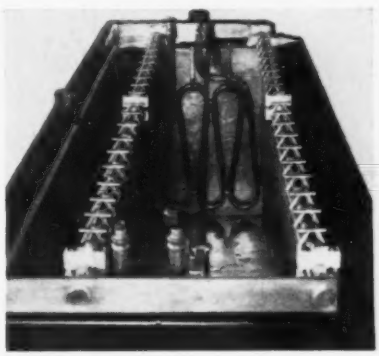

The Inside Story

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G. Miller, Mech. Eng., Chicago, Milwaukee, St. Paul & Pacific R.R., Milwaukee, Wisc.; *J. R. Trimble*, Asst. Mgr., Dept. of Metallurgy, Tenn. Coal, Iron & R.R. Co., Birmingham, Ala.

Corrosion Course at Case Institute

Nine lecture periods with adequate time for discussion have been scheduled tentatively at Cleveland, Ohio, for the *Case Institute of Technology* corrosion short course to be held September 25-29, under direction of *Dr. R. B. Hoxeng*. Dr. Hoxeng said the lecture course is designed as a refresher for those actively engaged in corrosion prevention, yet will not be too advanced for those just entering the field.

Authorities in the field of corrosion and corrosion prevention who have accepted are *F. L. LaQue*, The International Nickel Co., Inc., New York; *Dr. R. B. Mears*, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.; *H. A. Robinson*, Dow Chemical Company, Midland, Mich.; *Prof. Mars G. Fontana*, Ohio State University, Columbus, Ohio and *Professors W. von Fischer, E. G. Bobalek* and *R. B. Hoxeng* of Case Institute. Of the lecturers Mr. LaQue and Dr. Mears are past presidents of the National Association of Corrosion Engineers; Dr. Fontana is chairman of the NACE technical practices committee and the others are noted for their contributions to corrosion science.

The Case Institute course is the second such undertaking in which NACE has cooperated, the first being at the University of Texas, Austin in September, 1949.

Case lectures will be given two daily except Friday during the week of September 25.

Housing is available in a hotel adjacent to the Case campus, and meals will be served in the college cafeteria. Room and board will be arranged for those desiring it at a cost not to exceed $7 daily. Further information and official application blanks will be available on request from *R. B. Hoxeng, Case* Institute of Technology, Cleveland 6, Ohio.

Tentative Schedule
Corrosion Short Course

MONDAY, SEPTEMBER 25
- a. Fundamentals
- b. Fundamentals

TUESDAY, SEPTEMBER 26
- a. Pertinent Fundamentals of Metallurgy
- b. Types of Corrosion and Choice of Materials

WEDNESDAY, SEPTEMBER 27
- a. Use of Inhibitors and Chemical Treatment
- b. Electrolysis and Cathodic Protection

THURSDAY, SEPTEMBER 28
- a. Protective Coatings—Fundamentals
- b. Protective Coatings—Application

FRIDAY, SEPTEMBER 29
- a. Designing to Prevent Corrosion

News from California

Merit Products Co., manufacturers of Sand-O-Flex polishers, have moved from 4373 Melrose Ave., Los Angeles, to *4023 Irving Place, Culver City, Calif.*, where, general manager *Harry Pokras* reports considerably enlarged manufacturing and office facilities are available.

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Specialists in Corrosion-Proof Construction

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★ Reduces pitting and roughening
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UNIVERSITY OF MICHIGAN LIBRARIES

James L. Roberts, formerly in the research department of Lockheed Aircraft Co., and lately in the purchasing department of the University of Southern California, has joined the staff of the *Spazier Chemical Co.*, Santa Monica, Calif., manufacturers of industrial compounds, strippers, and cleaners.

Schlage Lock Co., South San Francisco, Calif., has installed a large new fully-automatic anodizing machine, with 300 feet of conveyor, which is designed to handle parts from raw aluminum to the finished product. This unit supplements a hand operated facility. The firm now is equipped with a full automatic setup for barrel plating, chrome plating and anodizing locks and lock parts. The machinery is LaSalco designed, engineered and installed by *Shepard & Kent*, of Los Angeles.

Gene Rynkofs, production manager of the *Liberty Plating Co.*, Los Angeles, and Mrs. Rynkofs, motored to Batesville, Ark., in May for a visit to her parents. The return trip was via Arkansas, Texas, New Mexico, Arizona and Las Vegas, Nev.

Jack Stone, of the *Los Angeles Chemical Company's* plating supply department, spent his June vacation motoring to Detroit, Mich., where he visited the *Udylite Co.* plant, among others, and also purchased and drove back a new Packard automobile.

George R. Huffman, formerly an account executive with the Wank & Wank Advertising Agency in San Francisco, has been appointed advertising manager for *E. W. Bullard, Co.*, San Francisco, manufacturers of industrial safety equipment. *E. W. Bullard, Jr.*, has been named assistant to the vice president in charge of sales, *Alpheus Bull*.

Cal Plating Company opened for business in May at *835 Kohler St.*, Los Angeles, as a job metal shop for polishing and plating work for the furniture trades.

Harry Hays has announced opening of *United Metal Polishing Co.* at 8660 Rheem Ave., South Gate, Calif. The shop specializes in polishing work for automobile assembly plants.

Stauffer Mfg. Co. has moved from 8424 Otis Ave., South Gate, Calif., to a new and larger plant at 1109 S. Merced Ave., El Monte.

Wyandotte Chemical Corp. has acquired the Los Angeles plant of the American-Marietta Co. The Wyandotte Company is a producer of industrial chemicals and cleaning and sanitation compounds.

Holly Manufacturing Co., producers of gas ranges, expected to have a plant addition completed at 875 S. Arruyo Parkway, Pasadena, Calif., by the end of August.

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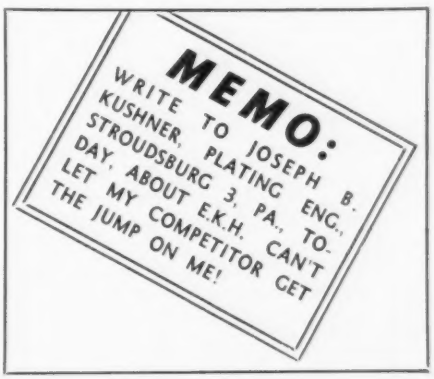

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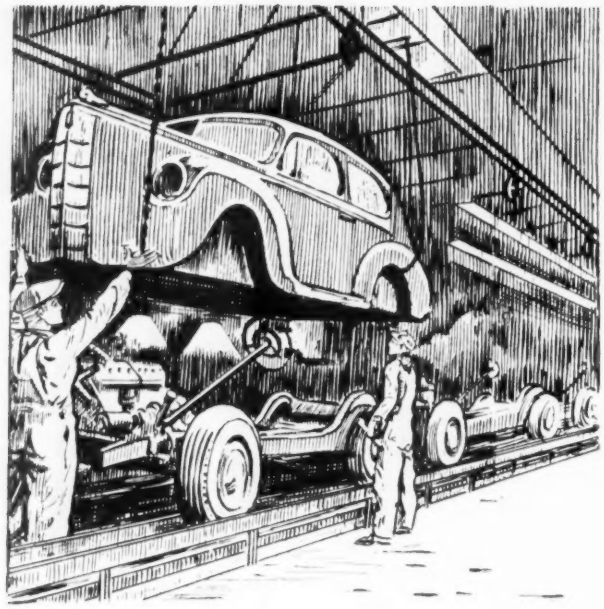

MOTOR CITY PLATING NEWS

by

Edward Finne

The *Plating Institute of Michigan*, an organization of job shop owners, held its May meeting at the Detroit Athletic Club on the 10th of the month.

This was a dinner meeting and the business session following was devoted mainly to labor's current drive for pensions and its effect on job platers.

****

The *G. L. Nankervis Co.* has moved its General Offices and Factory to larger quarters at 19255 W. Davison, Detroit 23.

****

Frank J. Kennedy, recently vice-president in charge of manufacturing at Briggs Mfg. Co., has taken over complete management, sales and production of the *All Metals Pickling Corp.*, 2631 Parkinson, Detroit.

Hank Tiedeman of *Wagner Bros., Inc.* had some bad luck on his trip home from the Boston convention. His car was demolished while it was parked about 40 miles out of New York. The 2 week old new car was hit by a 4 day old automobile!

****

Frank Watt has been promoted to general sales manager of the metal finishing equipment and supplies division of *Frederic B. Stevens, Inc.*

Widely known throughout the plating industry, Frank has been a member of the Steven's sales and engineering department for 17 years. In addition to his new duties, he will continue contributing to the engineering and design of Steven's plating equipment.

****

Jim Malone, vice president of *United Platers, Inc.*, 929 Madison, Detroit, was married May 20th at St. Vincents Church.

His bride, the former Ingeborg Jehle, is a German girl who has been in this country 8 months. She speaks very fluent English and was the first German hired by the U. S. Military Government in Stuttgart, Germany, as an interpreter in the postwar era.

Mrs. Malone had been working for a Detroit travel bureau and was introduced to him by his oldest son.

****

The American Plating Rack Co., 232 North Rosemary, Inkster, Mich., has been appointed by the *Norton Company* as distributors of Norton alundum tumbling abrasive.

Del W. Dyer, president, also states that the company conducts job tumbling and consultation services.

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